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GENERAL REPORT

ATOMIC BOMB CASUALTY COMMISSION

January 1947

NATIONAL RESEARCH COUNCIL
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FOREWORD

The report by Dr. Austin M. Brues and Dr. Paul S. Henshaw is one of the series of studies which have been made on the medical and biological effects of the atomic bombs dropped in Japan. The initial American investigations were made by a joint Army and Navy commission and the findings of this commission constitute the first American analysis of the casualties. Various Japanese investigations of the atomic effects had been made even before the American commission entered Japan. Many data are, therefore, contained in the various documents and the present report grew naturally out of the necessity for a continuing study of these medical and biological effects.

The National Research Council's connection with the problem came through a letter from the Surgeon General, U. S. Army, written in May 1946, to the Chairman of the Division of Medical Sciences. In this letter, General Kirk pointed out the desirability of a careful follow-up of the Japanese casualties and requested that the Council undertake a survey of the possible methods of achieving the desired results. As a result of General Kirk's letter, a conference was held in the National Research Council on 28 May 1946, with both civilians and representatives of the federal services in attendance. Out of the deliberations of this group grew a series of recommendations which were transmitted to General Kirk. It was pointed out that in order that too much time should not elapse, an interim mechanism should be established whereby competent civilians would be appointed as consultants to the Secretary of War and dispatched to Japan as soon as possible. Furthermore, the committee recommended that steps be taken looking to the establishment of a permanent organization for continuing long-term study of the biological and medical effects of the two bombs.

As a result of the recommendation suggesting interim action, General Kirk asked the Division of Medical Sciences of the Research Council to suggest a number of qualified civilians. General Kirk selected Dr. Austin M. Brues of the University of Chicago, and Dr. Paul S. Henshaw of the Clinton Laboratory of the Manhattan District, as civilian investigators. Both of these individuals had had extensive experience in study of the biological effects of atomic energy and were eminently qualified for the mission. Dr. Brues and

Dr. Henshaw were dispatched to Japan in the late fall, accompanied by two medical officers of the Army and one medical officer of the Navy. The findings of these medical scientists are given in the report and constitute a discriminating summary of the biological and medical effects on man of the huge radiation. It portrays also the attitude of the Japanese towards the whole problem. It is my feeling that Dr. Brues and Dr. Henshaw conducted a very successful expedition and made a contribution of great merit to the whole subject. Interest in the Commission's survey was not confined to the War and Navy Departments; civilian biologists and physicians were also intensely interested in the whole undertaking. The aspects of the radiation-effects which concern neoplastic disease, led the American Cancer Society to make a small but thoroughly useful contribution to the enterprise.

During the period when Dr. Brues and Dr. Henshaw were in Japan, the National Academy of Sciences - National Research Council received a Presidential Directive instructing the National Research Council to undertake a long-range, continuing study of the biological and medical effects of the atomic bomb on man. The Council was, under this Directive, authorized to enlist the aid of the governmental agencies and personnel and of such civilian agencies and personnel as may be needed.

To meet the stipulations of the Presidential Directive, the National Research Council is now proceeding to appoint a standing committee which will undertake the supervision of long-term continuing studies of the nature required by the problem. The activities of this committee will be carefully correlated with the responsibilities of the Atomic Energy Commission and will provide a mechanism for an enduring study of the medical and biological effects of the atomic radiation, especially on man. To the work of this newly established committee, the report of Dr. Brues and Dr. Henshaw makes an important contribution.

Lewis H. Weed, M. D.
Chairman, Division of Medical Sciences
National Research Council

GENERAL REPORT

ATOMIC BOMB CASUALTY COMMISSION

January 1947

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Paul S. Henshaw, Ph. D.

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Acknowledged

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PREFACE

This report was prepared with one thought in mind -- the supplying of background information useful in setting up a long-term program for study of atomic bomb casualties.

Before embarking upon its investigation the present commission had the advantage of access to the Medical Report of the Joint Commission for the Investigation of the Effects of the Atomic Bomb in Japan. This detailed report, now being edited for early publication by the War Department, includes not only a clinical survey of survivors but also a careful analysis of the pathological lesions encountered. It was prepared under the general direction of Col. Ashley W. Oughterson, M.C., A.U.S., chairman of the Joint Commission, Col. Stafford L. Warren, M.C., A.U.S., representing the Manhattan Engineer District and Captain Shields Warren, (M C), U.S.N.R., representing the Navy.

The present report has been purposely over-weighted with Japanese material to indicate both the character and quantity of Japanese work. With the exception of the short discussion on burn scars, (Appendix 5, Part III), no technical information has been presented by the American group. On the other hand, a rather large amount of technical information on atomic injury to date is presented in the Japanese Medical Report, (Appendix 9, Part III.) It should be emphasized that Appendix 9 is a summary paper prepared exclusively by Japanese without American aid, and without access to classified information.

PART I

ATOMIC BOMB CASUALTY COMMISSION

GENERAL REPORT

Paul S. Henshaw and Austin M. Brues

JANUARY 1947

An understanding of relations between the armed forces, military government, and the Japanese government has been found to be essential for a picture of the Japanese situation. In addition, knowledge of the social and scientific outlook of the post-war Japanese is desirable.

SCAP - The responsibility of Supreme Commander Allied Powers, General Headquarters, is to deal with all matters of occupation relative to the Japanese people. This organization is entirely distinct from the military forces, Army Forces Pacific (AFPAC), posted throughout the islands, which maintains order. The military forces are not responsible for policing the Japanese, and would be called for this only in the event of a major insurrection.

FEC - General MacArthur, in his capacity as Supreme Commander of the Allied powers (SCAP) in Japan, is subordinate to the Far Eastern Commission (FEC) which meets in Washington and is composed of representatives of the occupying nations.

MEDICAL AFFAIRS - The function of the office of the chief surgeon, AFPAC, is to care for the health of occupying troops. Health matters relating to the Japanese are handled through the Public Health and Welfare Division of SCAP, and since the Atomic Bomb Casualty Study is clearly a health problem affecting Japanese only, the Commission found itself automatically under this Division. Excellent liaison and cooperation are maintained between the two offices, however, so that the Commission was very substantially aided by the office of the chief surgeon by virtue of its supply function.

A. THE COMMISSION

1. Formation:

During October, 1946, the Atomic Bomb Casualty Commission (ABCC) was formed as a result of collaborative efforts on the part of the National Research Council, the War Department, the U. S. Navy, the Public Health Service, and the American Cancer Society. The details of formation are set forth in Appendix 1.

Since the work of the Commission was to be carried out mainly in occupied territory, the War Department, through the Supreme Commander, Allied Powers, was asked to assume responsibility for the operational details. These, it may be said, were handled in an extraordinarily efficient manner.

The Commission was composed of two civilians, Dr. Austin M. Brues and Dr. Paul S. Henshaw; and three military officers, 1st Lt. Melvin A. Block and 1st Lt. James V. Neel, M.C., A.U.S., and Lt. (j.g.) Frederick W. Ullrich, (MC), U.S.N.R.

2. Objectives:

The Commission has functioned primarily in these ways: first, obtaining some first-hand technical information, and second, making a detailed report pertaining to the opportunities for a long-term study of atomic bomb casualties.

B. ACTIVITIES

1. The Commission arrived in Japan 24 November 1946 and acquainted itself as rapidly as possible with the operational procedures of the military occupation.

2. It visited Hiroshima and Nagasaki, surveyed the work being done, and ascertained the requirements for setting up a full-scale study.

3. It took certain steps in providing for an interim program between the present work and that to be carried out by a more permanent organization which is anticipated.

C. FINDINGS

1. The Commission learned that the Japanese have a well organized medical group under the auspices of the Japanese National Research Council, which is carrying out studies on both immediate and delayed atomic bomb damage in people. This organization involves investigation in at least seventeen different universities, colleges, and sanatoria (cf. Appendices 2 and 3).

2. It learned that despite great difficulties since the war, the Japanese have prepared as many as 119 manuscripts on atomic bomb injury (Appendix 3) and that these are available for publication. Whereas the studies are somewhat lacking in critical analysis according to the best scientific methods, they nevertheless represent work carried out under the most difficult circumstances and covering a set of conditions which cannot be reproduced. It is therefore, the attitude of the Commission that these papers should be preserved in whatever form the authors are willing to submit them.

3. The Commission was able to assist materially in clearing the way for publication of the Japanese reports. The plan of the Japanese calls for a four-volume monograph series (cf. Appendix 4).

4. A review of the Japanese program for long-term study indicated that practically all of the approaches considered by the Commission had also been visualized by the Japanese. The Commission suggests, however, that more thoroughness, especially in connection with controls, would be desirable. In every case, the Japanese expressed an interest in more adequate planning as long as it is compatible with facilities.

5. Realizing the need for reliable vital statistics in connection with several phases of a long-term study, the Commission investigated Japanese laws and customs governing sterilization, infanticide, autopsy,

methods of recording births, etc; it had meetings with Public Health officials, Midwives Associations, and other groups. All such groups displayed interest and while difficulties were encountered, no insurmountable problems appeared to lie ahead.

6. The Vital Statistics Section of Public Health and Welfare, SCAP, was approached regarding work in vital statistics at Hiroshima, Nagasaki, and suitable control cities. It appears that some unusual opportunities for mutual assistance are in prospect (cf. Appendix 7).

D. GENERAL IMPRESSIONS

1. The Commission's view that much valuable information can be obtained from a long-term study of atomic bomb casualties has been strengthened. The acute reaction, consisting of atrophy and repair, has for the most part passed. At the present moment, the most prominent feature is massive scar formation at the sites of burn wounds; these appear to present some new - perhaps unique - problems in surgical treatment. From previous irradiation experiences with both animals and human beings, there is good reason to believe that reproductive disturbances, malignancies of one form or another, shortened life span, altered genetic pattern, etc., will in time appear in greater or lesser degrees. The problem is one of detecting the changes and recording the events as they occur.

2. It is the view of the Commission, furthermore, that with the possible exception of genetic recessives (cf. Appendix 6), the various changes can be successfully detected and recorded. This presupposes of course the proper cooperation with the Japanese and a reasonable expenditure of funds.

E. ACCOMPLISHMENTS

1. Assuming that some kind of long-term program will be established, the ABCC has taken certain steps: (a) to provide for an interim program, and (b) to open certain channels for future development.

2. Arrangements were made for Lts. Block and Neel to remain in the area on an interim basis to maintain continuity between the present visits and those which are expected.

3. After considering various locations, Kure (30 miles from Hiroshima) was selected as the most suitable control city.

4. Temporary arrangements for working space have been made at the Red Cross Hospital in Hiroshima and at the Mutual Relief Hospital in Kure. These consist of 3 rooms at the former and 2 at the latter to be used as office, laboratory, and examining rooms during the interim period. Through Army facilities, adequate equipment has been provided.

5. Through SCAP, arrangements were made for certain Japanese personnel to assist Lts. Block and Neel as needed.

6. Clear channels have been opened for handling any future developments through SCAP.

7. Provisions were made for transient visits only to Nagasaki during the interim period.

F. FUTURE ORGANIZATION

1. If a long-term organization is to be set up, it is desirable that this be done quickly; this is because information is being lost as time passes and because the Japanese are anxious to plan their program in accord with ours.

2. In accordance with the recent Presidential directive which authorizes the National Academy of Sciences to utilize any Government facilities to set up such an organization as has been visualized for a study of atomic bomb casualties, it would seem appropriate to provide the conventional organizational structure - that is, an advisory board of 3 to 5 scientific experts, a director with attendant officers and a scientific staff. Such an organization would be unique in that there would be required foreign and domestic components. Both would of necessity be closely integrated with the Japanese organization which is already functioning. It follows then as a next step that the Academy should exercise the initiative in providing an advisory board and one or more of the main officers. The remainder of the organization might then be left in the hands of such a group.

3. The ABCC has recognized certain aspects which will probably influence the organizational planning: (a) it seems desirable that the major part of the work be done by the Japanese, thus placing the Americans in the position of expediters and expert scientific consultants; (b) such consultants then would find it necessary to hold two positions - one in the United States, such as a university teaching or research position, and the other a consultant's position; (c) under these circumstances, a rather large portion of the budget would necessarily be devoted to travel.

4. Some consideration must be given to the advisability of a larger organization with quarters in Japan. This might well include one or more research hospitals. Such quarters, in addition to providing much needed general facilities, would aid the long-term studies of atomic bomb injury and help greatly in securing personnel for long periods.

G. INTERNATIONAL ASPECTS

1. The most vivid impression gained by the Commission was the conviction that a development such as a long-term study of atomic bomb casualties in collaboration with the Japanese, affords a most remarkable opportunity for cultivating international relations of the highest type. As indicated in Part II, the military influence and the overlordship in Japan have been removed. There remains then a people eager to adopt the

democratic principles insofar as they will serve Japan. Japan at this moment is extremely plastic and has great respect for the occupation. If we continue to handle Japan intelligently during the next few years while the new policies are being established, she will be our friend and ally for many years to come; if we handle her unwisely, she will drift to other ideologies. The ABCC or its successor may be able to play a role in this.

2. It would be in keeping with the best scientific tradition and ideals if the National Academy of Sciences would send scientific men of vision to Japan as an advisory team or panel.

3. The fate of Japan lies much more in the hands of Americans than most Americans realize; moreover, it may also be said, that the fate of America will be determined much more by the establishment of policies in Japan than most Americans realize. Because of the ascendant leadership of science today and because of American position, American science must of necessity accept a large measure of the responsibility for development.

PART II

REMARKS ON THE CURRENT SITUATION IN JAPAN

Austin M. Brues and Paul S. Henshaw

15 January 1947

The Commission has also had occasion to deal with the Economic and Scientific Section (ESS) of SCAP, since it must work with Japanese scientists.

RELATION TO THE JAPANESE GOVERNMENT - The divisions of SCAP do not deal directly with the Japanese people, but work with their parallel divisions of the Japanese government (in this case, the Ministry of Welfare). The Minister of Welfare and his subordinates are, therefore, frequent visitors at the Public Health and Welfare Division of SCAP. It is the policy of SCAP to try to get the Japanese on their feet as soon as possible and to allow the Japanese government as much autonomy as possible. Therefore, SCAP tries to avoid issuing directives to the Japanese government, but rather makes recommendations which are the basis of directives by the Japanese ministries. The reason for this is that the war-weary Japanese tended, early in the occupation, to avoid responsibility and let the occupying forces take care of them. General MacArthur's policy is to avoid this situation at all costs. This policy leads to certain small complications when there is a particular job to be done, but it seems to be unanimously agreed that the overall results of this policy are excellent and that it should be maintained until (as a result of its own efforts) SCAP is no longer necessary.

SCAP AND THE JAPANESE NATIONAL ECONOMY - In accordance with SCAP policy, a minimum amount of material aid is given the Japanese government. Thus, penicillin is being withheld from the Japanese, although all aid is given them in planning for its large-scale manufacture. This is said not to be done in a spirit of vindictiveness but in order to ensure that the Japanese commence large-scale manufacture at the earliest moment.

In carrying out its functions, SCAP makes use when possible of Japanese personnel and materials. Cost of materials and labor are charged off as cost of occupation. This is distinguished from reparations, which are materials taken as costs of war and distributed largely to China and Russia. Where personnel and materials of American origin are used, they are paid for out of SCAP's budget, and hence it is impossible at present for an independently financed American organization to operate in Japan. The only exception to this is certain missionary groups, which are required to act wholly on their own, getting Japanese food, housing and supplies. SCAP appears willing, however, to support in a substantial way any important project in Japan.

The ensuing discussions represent a picture formed as the result of many contacts, American and Japanese, high and low, and opinions are expressed only where there is a great measure of agreement among different sources.

LIFE IN JAPAN - The Japanese are said to have the highest standard of living in the Orient, but it is very low according to our standards and also in comparison with that in Japan before the war. Over half of the houses have been destroyed in many communities, and wood for reconstruction is short. Also, many of the best buildings and houses have been offered us by the Japanese government for use in the occupation. A man

can easily carry his winter's supply of charcoal home from the ration depot in his hands. Where windows have been broken, no glass is available for repair. Sand, of course, is available to make glass, but there is no heat. Many men (including some prominent individuals) wear used Army clothing and canvas shoes). A little gasoline is available, but most Japanese trucks and busses are fitted with charcoal burners which feed carbon monoxide to the carburetors.

FOOD - Although every available square foot of tillable soil is utilized, food, especially rice, is strictly rationed. It is due in a large measure to the necessity for conserving food that Allied personnel are excluded from Japanese restaurants and hotels. The railroads are tremendously overcrowded with Japanese travelers, most of whom are traveling from the city to the country to get food for their own use, or from the country to the city to sell it on the black market. Two dogs and no horses were seen in six weeks; a few oxen are used to carry burdens in rural districts.

There is no gross evidence of malnutrition among the Japanese, but it seems probable that subclinical deficiency states are common. This is suggested by the mild anemias in such control population as have been observed. The markets show dried squid and octopus meat. Garbage cans containing the scrapings from infected animal cages in the American medical laboratories must be kept locked to keep hungry Japanese from stealing scraps of vegetables, etc., and using them for food.

ECONOMICS - A moderate inflation is under way in Japan. The yen, which was worth about 50 cents before the war, has been pegged at 15 to the dollar, with purchase of yen permitted but sale prohibited. It is said that yen can be obtained in many places at the rate of 50 or 60 to the dollar, and it is not clear what becomes of the dollars used in their purchase, as they cannot be spent in Japan. Comparison of prices of various standard articles suggests that the true equivalence is 75 to 100 yen to the dollar.

As in other occupied countries, American cigarettes are greatly in demand, much more so than food. Consideration of the price of Japanese cigarettes (3 yen each) and frequent rumors indicates that a carton of cigarettes would, if illegally sold, yield 400 to 500 yen.

HOSPITALS - The Japanese economic situation is epitomized in the hospitals. They are unheated except for one or two charcoal pots burning a few fragments of charcoal in each ward; the limited coal ration is devoted to sterilizing. Many windows are broken, and there is no glass for repairs, so that cold air blows through the corridors and down some wards and clinics. Radiators were removed for scrap metal during the war, but generally have been left rusting in the hospital yard.

Due to scarcity and rationing of food, no central kitchen facilities are available, so that families of patients bring in their rations and heat them over the charcoal pots, and also feed the patients. The floors, linen, etc., are usually dirty; this may in part be due to the shortage of soap, although no entirely satisfactory explanation was found.

ATTITUDE OF JAPANESE TOWARD THE WAR - It is a commonplace among Japanese that the war was a good thing. The explanation, given by many

Japanese of all ages and types, standing among the ruins, is essentially simple: the unsuccessful war eliminated certain social nuisances and created certain reforms which could never have happened in any other way. This seems to be the opinion in all classes except those close to the Zaibatsu (feudal lords).

The position of the emperor is paradoxical. It is recognized that either (1) he used poor judgment in allowing the war to continue or (2) he was not properly informed as to the military situation. But the emperor is not expected to be a statesman but rather is a symbol, a role he fills well.

The position of Americans, from number one down, appears on the surface to be very secure. They appear to be, if not honored by the Japanese, at least respected. The commander of the Kure Naval Base, in charge of scrapping of Japanese warships, is a single officer aided by a staff of ex-naval officers of the Japanese navy, who have said that it is an honor to work with an organization which proved itself better than the best organization in Japan - its navy. The Japanese scientists appear eager to learn what they can about American methods and recent literature. Although there is no such thing as a "good" occupation, it is generally believed that the present occupation is as nearly good as one can be, partly due to the Japanese temperament and partly to the way in which the occupation has been handled, and that if present causes are followed and extended and if occupation funds are not cut or withdrawn, it is certain that the Japanese can become our strongest ally in what is a strategic part of the world.

THE PURGE - This represents the removal from public offices of all sorts, those Japanese who were closely allied with military activity and with the feudal overlords. Dr. Tsuzuki, who is a key figure in the Japanese Atomic Bomb Casualty Study, has been placed on the purge list and therefore, had to resign his position as Professor of Surgery at the Tokyo Imperial University January first because of military service. Whether he will be allowed to continue collaboration with SCAP is in doubt; although SCAP may be willing to encourage this, the more or less autonomous Japanese government is less inclined to allow liberal exceptions of this sort.

THE JAPANESE TEMPERAMENT - Japanese are polite (but with less elaborate formality, probably, than before the war). They are fatalistic about the war, which is only another of many disasters to which the Japanese are accustomed. Yet they are not stolid, but are a spirited people with a good sense of humor and much intelligence. It is interesting to see the almost universal reaction of men who 18-24 months ago were shooting and being shot by Japanese. These men appear to share this recognition of the Japanese character which is also held by those "feather merchants" in the occupation who have observed the Japanese only recently, arriving in the wake of the victors.

"Every Japanese must have a master," it is said. During the war, the master was the Army, which engineered the war against the better judgment of the navy. The master, now, is MacArthur and the SCAP organization, which is attempting to remove itself from this position without leaving a successor or a vacuum. The question of whether the Japanese can govern themselves remains to be seen, and may lie with the coming generation. If

they do learn to govern themselves, they will no doubt do it with wisdom, as the lawmakers will probably follow the will of the people with a care not seen anywhere else.

Babies and young children hardly ever cry, although in other respects they are spirited. The reason for this cannot be given.

The relations between men and women are somewhat unusual from the standpoint of an American. The husband is the unquestioned ruler of the household. In the case of a widow with no sons, the eldest daughter is legally completely responsible for the family, unless one daughter is married, in which case she, and the rest of her family, are subservient to her husband. The wife may occupy the position of a drudge, or may occupy place number one with her husband, as the case may be. In the former case, the man usually cuts a much wider and shallower swath than is usual in other countries, with a resulting high incidence of social diseases. This may even have some influence on the high tuberculosis rate. The possibility of congenital luetic children and stillbirths may become an important part of a genetic study. It has been considered that if children were educated in coeducational schools, which have never existed even for the lower grades, this might help to foster a new social relationship. Some of the SCAP members believe that this would represent undue interference by the occupation, and it is one of the few instances where SCAP has attempted something not given complete Japanese acceptance.

Marriages are still commonly arranged by parents, who investigate one another's families with great care. Since vital statistics records are open to the public, this is thought to influence the reporting of abnormal and stillbirths.

In the past century, western civilization has made a heavy impact on the ancient civilization of Japan. Since the war, Japan is ready for a deeper influence. Where this new social impact will be derived , is not yet known; America is certainly in an excellent position to exert it. No doubt other ideologies are at work; although they are not seen, they must be recognized. We must bear in mind that many of the sincere efforts in Japan are hampered by lack of support and by the manning of Japan by young American soldiers who have hardly learned the significance of their own system beyond the full dinner-pail. More attention should be paid to providing adequate communications for the military government. The occupation of Japan may well turn out to be, although eminently peaceful, one of the decisive battles of the world.

PART III

APPENDICES

APPENDIX NO. 1

MEMORANDUM TO COL. WILLIAM S. STONE, 14 November 1946

LONG-TERM FOLLOW-UP

ON ATOMIC BOMB CASUALTIES

APPENDIX 1 November 14, 1946

MEMORANDUM

To: Col. William S. Stone

From: Dr. P. S. Henshaw (For Dr. A. Brues and Dr. P. S. Henshaw)

Re: Long-term Follow-up on Atomic Bomb Casualties

The general background, objectives and mode of operation of the Follow-up Committee on Atomic Bomb Casualties is understood by the Committee (Dr. Brues and Henshaw, and Lts. Block, Neel and Ullrich) to be as follows:

On 15 May 1946, Col. A. W. Oughterson addressed a letter to the Surgeon General of the Army urging that the National Research Council be requested to make recommendations for the "planning and supervision" of a continuing study on atomic bomb damage to people. This suggestion was communicated by General Kirk on 28 May to Dr. Lewis H. Weed, Chairman, Division of Medical Sciences, National Research Council.

On 28 June, Dr. Weed replied after having consulted with representatives of the Army, Navy, Public Health Service, State Department, American Cancer Society and other groups, at a meeting chaired by Dr. C. P. Rhoads on 24 June. In the 28 June letter Dr. Weed recommended the following:

1. "That the Surgeon General, U. S. Army, and the Surgeon General of the Navy, inform the Chairman of the Division of Medical Sciences, National Research Council, that advice regarding studies of the atomic bomb casualties be considered part of the subject work under the overall contract for such services; and that the two Surgeons General request the immediate formation of a continuing council committee on this subject."

2. "That, if the formation of such a committee be approved by the Surgeon General, certain of the personnel of this committee be appointed Consultants to the Secretary of War, so that one or more members of the committee may be soon sent to Japan under military conditions to direct and stimulate the Japanese physicians in the continued study of the casualties and to establish relationships with the medical faculties of appropriate Japanese scientific institutions."

3. "That the Council's committee on atomic bomb casualties maintain a study of adequate breadth and detail, serving in an advisory capacity to the armed forces concerning policy, personnel and procedure, and soliciting funds from private agencies if federal funds become no longer available for this purpose."

In order that the long-range study could be continued even after the abandonment of military occupation under the present plan, the Conference-group of the Council (Weed's 28 June letter) voted to recommend that one of the following alternatives be effectuated by the Surgeons General of the Army, Navy and the Public Health Service:

(a) "That steps be taken looking to the issuance of a Presidential Directive, instructing the National Academy of Sciences - National Research Council to undertake a long-range, continuing study of the biological and medical effects of the atomic bomb on man. That in this directive, the Council be authorized to enlist the aid of government agencies and personnel as may be needed."

(b) "That steps be taken by the Surgeons General to request the President to create by Executive Order a Commission on Atomic Bomb Casualties, with power and funds to undertake the desired long range study. Such a Commission to be composed of one representative each of the three Surgeons General and of the Medical Director of the Veterans Administration and of five or more specifically qualified civilian scientists. The Commission could function in relation to the Research Council's Committee on the subject."

The Committee, composed of Brues, Henshaw, Block and Neel (Ullrich had not yet been appointed), met in Washington at the office of the National Research Council, 2101 Constitution Ave., Monday, 4 November, at which time the above details were outlined by Col. Stone and Dr. Weed. Others in attendance were: Col. Cooney, Manhattan Project; Capt. Dowling, Bureau of Research and Development, USN; Dr. Owen, NRC; Col. Mason, War Department; and Maj. Vogel, War Department. The Committee was asked to acquaint itself with all correspondence on the proposed follow-up program, to become familiar with the previously collected material and to make any helpful contacts prior to departure about 20 November.

Having now accumulated most of the views about a possible follow-up study, having seen a fair portion of the collected material and having seen something of the available facilities in Washington, the Committee conceives its activities to comprise:

1. A follow-up program concerned with all kinds of atomic bomb damage in people, especially the following:

Cancer
Leukemia
Shortened life span
Reduced vigor
Altered development
Sterility
Modified genetic pattern
Changes in vision
Shifted epidemiology
Abnormal pigmentation
Epilation

The Committee has no illusion about the difficulties of obtaining information of a late character, especially the genetic. In order to secure significant data on the latter within reasonable time, it may be necessary to resort to devious means such as examining conditions in animals (wild mice or Drosophila). Recovered persons will probably prefer to forget their tragic experience rather than submit themselves for examination. Some difficulty in connection with the securing of Japanese assistance may result from the recent purge orders. The Committee, however, is not pessimistic about the outlook providing a substantial long-term program can be set up - that is, several decades or longer depending on the genetic criteria established.

2. The function of the Committee will be two-fold primarily: (a) to obtain some technical information, and (b) to make detailed plans to submit as recommendations for a long-term program. In the accomplishment of these ends, it will be necessary to arrange and carry on a temporary technical study while developing plans for a long-term program. With respect to the overall program it would probably be desirable to have continuity between the temporary and the long-range organizations even if this must be on a very informal basis. Thus, it may be important to have certain members of the present Committee remain on field duty during the interim period.

3. In arranging for the interim organization, Japanese assistance will be solicited. Such work can be aided with the petty cash fund made available by the American Cancer Society through the Committee on Growth of the National Research Council. As a further means of encouraging the Japanese, they can now be told that certain of their articles have been cleared for publication. It is hoped that work with the Japanese will be on a high level and that they will wish to continue their contribution to science.*

4. Finally, the overall organization for the long-term program, as visualized at this time would need to consist of a central coordinating agency in Washington and a field component in Japan. Whether storage, analysis, publication, etc., should take place mainly from the Washington office or field headquarters can best be indicated later. It is quite clear, however, that continued cooperation must be maintained with the Manhattan District animal research and the Navy investigations on Bikini animals. Further, it is plain that the Atomic Energy Commission must be fully advised.

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* Author's note: Any misgivings about the intent of the Japanese soon were dispelled, as is amply evidenced elsewhere in this report.

APPENDIX NO. 2

JAPANESE MATERIAL

ORGANIZATION FOR STUDY OF ATOMIC BOMB CASUALTIES

MONTHLY PROGRESS REPORTS

The Investigation of the Effects of the Atomic Bomb
by the National Research Council in Japan

I. The description of its works

The National Research Council is a Government Organization for the scientific researches in Japan. The Special Committee for the Investigation of the Effects of the Atomic Bomb was established in the last September. Dr. Haruo Hayashi, the President of the Council, is also in charge of this Special Committee. The Committee consists of 9 sections:

1. Physical, Chemical, and Geographical Section
   Chairman, Dr. Masaharu Nishikwa, Prof. of Tokyo Imp. Univ.
2. Biological Section
   Chairman, Dr. Kaname Okada, Prof. of Tokyo Imp. Univ.
3. Engineering and Metallic Section
   Chairman, Dr. Masaichi Majima, Prof. of Tokyo Imp. Univ.
4. Electric Communication Section
   Chairman, Dr. Shoji Seto, Prof. of Tokyo Imp. Univ.
5. Civil Engineering and Architectural Section
   Chairman, Dr. Yutaka Tanaka, Prof. of Tokyo Imp. Univ.
6. Medical Section
   Chairman, Dr. Masao Tsuzuki, Prof. of Tokyo Imp. Univ.
7. Agricultural and Fishery Section
   Chairman, Dr. Ikusaku Amemiya, Prof. of Tokyo Imp. Univ.
8. Forestry Section
   Chairman, Dr. Ihachiro Miura, Prof. of Tokyo Imp. Univ.
9. Veterinary and Zootechnical Section
   Chairman, Dr. Kiyoshi Masui, Prof. of Tokyo Imp. Univ.

Many scientists of our country had been working since the time of bombing at Hiroshima and Nagasaki. Most of them jointed into the respective sections, when the Special Committee was established. All sections worked in their own circles, independently or cooperatively with other sections. The first general conference was held on November 30th, 1945, at the Tokyo Imp. Univ. The chairmen of all sections presented the reports, as preliminary ones. Comm. Tailor, Nav. Tech Jap of SCAP attended at that conference.

On February 28, 1946, the committee is going to have the second general conference, also at Tokyo Imp. Univ.; many reports will be presented by the representatives of all sections. All these reports will be checked up and the editing of an official report of the atomic bomb investigation is now planned, to keep the scientific data in perfect condition.

February 25, 1946

The Works of the Medical Section of the Special Committee for the Investigation of the Effects of the Atomic Bomb, by the National Research Council in Japan

Dr. Masao Tsuzuki, Professor of Surgery, Tokyo Imperial University

The Medical Section is the largest in the Special Committee, composed of about 30 committee fellows, 150 investigators and 1000 assistants, of almost all the big medical schools, institutes, and hospitals of Japan. Since the end of September 1945, the Medical Section has had always a close connection with the American Commission, in helping and discussing of their works. By the end of last December, about 80 reports were finished, most of them were translated and transferred to the American side.

In the Medical School, Tokyo Imperial University, the conferences on the atomic bomb studies were held and many papers were read by the members of our committee as follows:

The 1st Conference, December 19, 1945

1. Survey of the damage of the human bodies in some strong buildings at Hiroshima. Dr. Murati & Dr. Murai (Radiolog. Clinic).
2. Pathological Anatomy of the atomic bomb cases. Dr. Mayake (Path. Clinic).
3. Haemotological studies on the atomic bomb patients, Dr. Makao (Medical Clinic).
4. Increasing and disappearance of eosinophile cells in the peripheral blood of the atomic bomb patients at Nagasaki in the 3rd and 4th months after the explosion. Dr. Ueda Nikaido.
5. Stomach of the atomic bomb patients at Nagasaki. Dr. Kishimoto (Medical Clinic).
6. Cachectic condition of the atomic bomb patients. Dr. Urabe and Dr. Menjo (Surg. Clinic).
7. Experience on the treatments of the atomic bomb patients, Dr. Kuwabara (Surg. Clinic).
8. Clinical and pathological studies on cicatrical tissues of the burn wounds by the atomic bomb, Dr. Kajitani and Dr. Ishibashi (Surg. Clinic).
9. Sperma of the atomic bomb patients at Hiroshima. Dr. Ogoshi (Urolog. Clinic), Dr. Kaseki (Gyn. Clinic), and Dr. Asakura (Surg. Clinic).
10. Influence of the atomic bomb upon the female sexual functions, Dr. Mitsui, Dr. Ito, and Dr. Nozu (Gyn. Clinic).
11. Clinical cases of eye damages by the atomic bomb. Dr. Fukuoka and Dr. Nitta (Ophth. Clinic).
12. Rupture of ear drum by the atomic bomb. Dr. Kashiwado (Oto-r-laryn. Clinic).

The 2nd Conference, January 23rd, 1946

1. Topographic distribution of the atomic bomb patients at Nagasaki. (Dr. Ohashi (Pharm. Inst.), Dr. Urabe (Surg. Clinic), Dr. Ueda (Medical Clinic), Dr. Hakamada (Brain Inst.), and Dr. Nikaido (Physical Therapy).
2. Fever of the atomic bomb patients at Hiroshima, Dr. Kubo and Dr. Kitamoto (Med. Clinic).
3. Survey of the nutritional conditions of the atomic bomb patients at Hiroshima. Dr. Kubo (Med. Clinic).
4. Atomic bomb damages and pulmonary tuberculosis. Dr. Kitamoto and Dr. Ayukawa (Med. Clinic).
5. Capillary resistance of the atomic bomb patients at Hiroshima. Dr. Ayukawa (Med. Clinic).
6. Disturbances of the liver function and capillary function of the atomic bomb patients. Dr. Kobayashi (Med. Clinic).
7. Studies on the brains of atomic bomb cases. Dr. Okada and Dr. Shimazone (Psychiatr. Clinic).
8. Studies of the oral cavity and the Zanbrini-Watanabe's salivary reaction of the atomic bomb patients at Hiroshima. Dr. Akiyama (Dental Clinic).
9. Review of the courses of the investigation on the medical effects of the atomic bomb. Dr. Tsuzuki (Surg. Clinic).

The 3rd Conference, February 16th, 1946

1. Stochastic studies of mortality by the atomic bomb. Dr. Nasuyama (Physical Therapy Clinic).
2. Atomic bomb diseases, observed on the standpoint of radiation biology. Dr. Nakaizumi (Radiolog. Clinic).
3. Burn injuries by the atomic bomb. Dr. Tsuzuki (Surg. Clinic)

The 4th Conference will be held on March 2nd, 1946, and the following papers will be read:

1. Shelters and damages. Drs. Murati & Murai (Radiolog. Clinic).
2. Damages of the persons who were in a building, situated 200 meters from the centre of the explosion. Dr. Kitamoto (Med. Clinic) and Dr. Ishikawa (Surg. Clinic).
3. Statistical studies on the burned patients by the atomic bomb. Drs. Yasuda (Derm. Clinic), Kajitani, Hatano (Surg. Clinic), Ishikawa (Surg. Clinic), and Goto (Orth. Clinic).
4. Timely distribution of symptoms of the atomic bomb patients and the blood pictures after the second month. Dr. Ueda (Med. Clinic) and Dr. Nikaide (Physical Therapy).
5. Statistical studies on the blood pictures of the atomic bomb patients in the 3rd and 4th months. Drs. Nakao, Kakehi (Med. Clinic), Ogoshi (Urol. Clinic), Tsukada, Kato (Med. Clinic), and Kawamura (Ped. Clinic).
6. Plans for protection and rescue against the atomic bomb damages. Dr. Tsuzuki (Surg. Clinic).

The Special Committee for the Investigation of the Effects of the Atomic Bomb, Medical Section

(Chairman: Dr. Masao Tsuzuki)

Themes and Aims for the investigation of the Medical Section in 1946 year (April 1946 - March 1947)

1. Statistic Studies

All collected data of the casualties will be arranged statistically and stochastically and the actual fact of the damages of the peoples will be grasped surely.

2. Clinical Studies

The patients (about 6,000 cases at Hiroshima, about 6,000 cases at Nagasaki), who were investigated previously, will be followed-up repeatedly. Various disturbances, their recovering and remained symptoms will be checked. The following conditions are going to be studied at first more carefully.

a. burn
b. radiation sickness, especially blood pictures
c. disturbance of male sexual functions
d. disturbance of female sexual functions

3. Path-anatomical Studies

About 120 autopsy cases will be thoroughly studied and summarizing results will be fixed.

4. Studies of the remained radioactivity

The influence of the remained radioactivity upon the inhabitants of Nishiyama Districts, Nagasaki, will be followed-up repeatedly.

5. Hereditary Studies

The possible influence upon the coming foetus, children, and descendants will be studied, in cooperation with members of the zoological and botanical section.

MONTHLY REPORT - April 1st, 1946

The Works of the Medical Section of the Special Committee
for the Investigation of the Effects of the Atomic Bomb,
The National Research Council in Japan

(Dr. Masao Tsuzuki, Professor of Surgery, Tokyo Imperial University)

I. The Field Works

1. Dr. Asakura, Assistant of the Surgical Clinic, Tokyo Imp. Univ., has been in Hiroshima from Feb. 15th to 28th, 1946, to do the further investigation for the disturbance of the sexual function of male.

2. Dr. Neguchi, Assistant Prof. of Chemistry, Tokyo Imp. Univ., has been in Hiroshima and Nagasaki from Feb. 15th to 25th, 1946, to pick up some specimens for the further study of the remained radioactivity of the earth.

3. Dr. Mitani, Assistant Prof. of Obstetrics and Gynecology and other investigators in the Obst. & Gynec. Clinic, Tokyo Imp. Univ., are endeavoring to follow-up the females, who complained of some disturbance about their menstruation on the previous examination at Hiroshima in November 1945, in sending them personal questionnaires. Many replies are collected and arranged now for survey.

II. The Laboratory Works

1. Statistical and stochastical studies on the casualties at Hiroshima and Nagasaki are now going to be worked by many investigators in institutes and clinics. Faculty of Medicine, Tokyo Imp. Univ. Total casualties. Burn. Mechanical injuries. Radiation sickness, etc.

2. Summarized survey on the clinical features of so-called radiation sickness by a special team which is consisted of many investigators of medical clinics of various universities. The special conference will be held on April 2nd as a section of annual general meeting of the Japanese Society of Internal Medicine.

3. Summarized survey on the pathological anatomy of the atomic bomb cases by a special team which is consisted of many pathologists of various institutes. They are discussing once a week since the beginning of March.

4. Hematological survey on the people, who show remarkable increasing of their leukocytes in Nishiyama District, Nagasaki, by Dr. Ishikawa, Assistant Prof. of Radiology, Kyushu Imp. Univ., Fukuoka.

III. The Conferences

1. The 2nd general meeting of the Special Committee for the study of the Atomic Bomb Damage, National Research Council, was held on Feb. 28th at Tokyo Imp. Univ. The Chairmen of all sections read their papers, which presented some abstracts of the results of the investigation in their own fields.

2. The 4th conference of the Faculty of Medicine, Tokyo Imp. Univ., was held on March 2nd. Six papers were read. The list of them was presented in the previous report, dated Feb. 25th, 1946.

3. The Committee of the Study of the Atomic Bomb Damage in Okayama Medical College reported the result of their investigation before the annual meeting of the Okayama Medical Association on March 29th.

IV. The Reports which are finished and presented through Surgeon's Office to the Joint Atomic Bomb Commission.

1. Patho-anatomical studies on 34 atomic bomb cases at the city of Hiroshima and Nagasaki (the first report), by Dr. M. Miyake, Pathological Institute, Tokyo Imp. Univ.

2. Clinical researches of ocular affections caused by atomic bomb explosion at Hiroshima, Japan: by Dr. Y. Shoji and Dr. T. Fukuoka, Ophthalmological Clinic, Tokyo Imp. Univ.

3. The 4th report of the influence of the atomic bomb explosion on the ear, nose, and throat: by Dr. T. Kashiwade, Oto-r-laryg. Clinic, Tokyo Imp. Univ.

4. Investigation of injuring effect upon the human body by the explosion of atomic bomb at Nagasaki city: by Dr. R. Nakajima and Dr. K. Ishikawa, Dept. of Radiology, Kyushu Imp. Univ.

5. The influence of the remained radioactivity upon the inhabitants of Nishiyama District, Nagasaki (the 2nd report): by Dr. K. Ishikawa, Dept. of Radiology, Kyushu Imp. Univ.

6. Influence of atomic bomb upon the growing zone of the bone: Dr. S. Jinnaka and others, Orthopedic Clinic, Kyushu Imp. Univ.

7. Memoranda on the self-experience of the atomic bombing as a medical man: by members of the Nagasaki Medical College.

8. The effects of atomic bomb on the human beings at Hiroshima: by Dr. M. Fujii and others, Hiroshima Sanatorium, Saijo.

M O N T H L Y R E P O R T - May 1st, 1946

The Works of the Medical Section of the Special Committee for the Investigation of the Effects of the Atomic Bomb, The National Research Council in Japan

(Dr. Masao Tsuzuki, Professor of Surgery, Tokyo Imperial Univ.)

I. The Field Works

1. Dr. Tsuzuki, Professor of Surgery, Tokyo Imperial Univ., Chairman of the Medical Section, accompanied by Dr. Hatano, has been in Hiroshima from April 20th to 27th, to get a general idea about the present condition of the City of Hiroshima. The social life of the citizen has recovered already partly from the devastated situation. Dr. Tsuzuki inspected there various municipal and medical organizations and decided to send a special investigation party over there in the middle of May in order to perform further studies from the medical standpoint.

2. Accordingly, a special investigation party will be sent to Hiroshima in the middle of May. The party consists of about 10 medical men who are belonging to the various clinics of Tokyo Imp. University and most of whom have worked as members of Joint Commission. They will stay at Hiroshima about two weeks and they will follow-up the cases who were examined previously. Some of them will go to Nagasaki after finishing their work at Hiroshima.

3. The principal articles for the surveys of the special investigation party are as follows:

a. General health conditions around the city.
b. Sequelae of the mechanical injuries by the atomic bombing.
c. Late effects of the radiation sickness.
d. Sexual life of the citizen, conception, pregnancy, birth, puerperium and baby, etc.

II. The Laboratory Works

1. An official report of the Medical Section is almost ready, now being translated.

2. Special reports concerning patho-anatomical, clinical, and radiological affairs are now going to be edited.

III. The Reports which are finished and presented through Surgeon's Office to the Joint Atomic Bomb Commission.

1. Hematological studies on the atomic bomb disease: by Dr. Nakao, Medical Clinic, Tokyo Imperial University.

2. On the late radiation sickness, caused by the atomic bomb: by Dr. Yamasaki, Oto-r-laryng. Clinic, Osaka Med. School.

M O N T H L Y R E P O R T - June 1st, 1946

The Works of the Medical Section of the Special Committee for the Investigation of the Effects of the Atomic Bomb, The National Research Council in Japan

(Dr. Masao Tsuzuki, Professor of Surgery, Tokyo Imperial Univ.)

Report on the Medical Investigation of the Late Effects of the Atomic Bomb at Hiroshima.

1. A special investigation party was sent to Hiroshima from May 10th to 27th. The party consisted of 12 medical men who are belonging to the various clinics of Tokyo Imperial University and most of them had been working as members of the Joint Commission since last year. Dr. Tsuzuki, Chairman of the Medical Section, has been also there with the party.

2. The party stayed at the Ujina Hospital, Hiroshima, in two weeks and worked out dividedly in four groups at the Ujina Hospital, the Red Cross Hospital, the Post Office Hospital, and the Kusatsu Hospital. Over 1000 patients were examined thoroughly, most of them were given adequate advices and treatments if necessary.

3. The principal items and their results of the surveys of this party are as follows:

a. Public Health Condition of the City: The situation of the public health of the City of Hiroshima is now becoming better. The appearance of the devastated area is partly cleaned already, many barracks are built, many shops are opened for meals, daily goods, and even souvenirs. The city authority is now endeavoring to establish a new plan for reconstruction with the aid of the advisers, who are appointed by the Supreme Command of Allied Forces.

b. Sequelae of the Mechanical Injuries and Burns by the Atomic Bombing: The mechanical and burned wounds are cured already on the whole. As sequelae after these kinds of wounds, now there are pretty many patients who are complaining of some disturbances concerning contracture, keloid of the scars, and so on.

c. Late Effects of the Radiation Sickness: The patients who were suffering from the so-called radiation sickness are now mostly recovered clinically as well as hematologically. Few patients are still complaining of some symptoms, i.e., general fatigue, weakness of concentrating spiritual power, disturbances of digestive organs and diarrhea. They are mostly over 50 years of age. Very few patients show still anemic condition, hemoglobin contents are sometimes under 50%. Most of those patients located within the circle of 1 km from the center at the time of bombing. Epilation of the scalp hairs, caused by the radiation effect, had been recovered perfectly. New growing hairs seem to be somewhat thicker than the falling ones.

d. Sexual Life of the Patients: Abnormalities of menstruation, mostly temporal amenorrhea during 2-3 months after bombed, recovered already. Many wives have been pregnant. No abnormality of the courses of birth and puerperium has yet been proved. Newborn babies are all normal and healthy. As regard to the sexual function of male, few patients are showing still oligo-rest aspermia. Perhaps there will remain a few cases which are acceptable as a permanent aspermia.

25 June 1946

To the Joint Commission for the Investigation of the Effects of the Atomic Bomb in Japan.

Dr. Masao Tsuzuki, the Japanese Government Group, would like to have immediately the directions on the following articles.

1. The printing of the official reports of the National Research Council in Japan: The official reports of the each sections of the Special Committee are now almost ready in their original texts and going to be translated. The National Research Council wants to print them provisionally in order to present to the Joint Commission and deliver among the investigators of each section to promote the further study.

2. The publication of the scientific reports of the Japanese investigators: Many reports are finished and waiting for publication. The authors are very much anxious to publish them on some Japanese scientific journals. They would like to have a permission from the Joint Commission to do so as soon as possible.

3. The further management of the Japanese Government Group: Dr. Tsuzuki will resign soon from his post of the Professor at the Tokyo Imperial University by the purge directive, because he was active as a naval surgeon in six years after the graduation of the medical school. Can Dr. Tsuzuki continue his management in the Japanese Government Group after his resignation from his official post? Or, anyone else must replace his position to take care of?

July 15, 1946

The Influence of the Atomic Bomb upon the Functions of the Female Genital Organs.

S. Mitani, M. Ito, S. Nozu, Y. Tumuji, T. Kaseki
T. Iwai, M. Iwatate, M. Watanabe (from the Gynecological Clinic of the Tokyo Imperial University).

At Hiroshima we investigated the influence of the atomic bomb upon the general healthy conditions, especially upon the functions of the genital organs of the females, since September 10, 1945. We examined 343 women, from 18 to 45 years of age, who previously had shown the regular menstrual conditions. Among the women who were not in concrete buildings at the time of the bombing, there was a large number of those who have shown some disorders of menstruation. Table I shows the relationship between the distance from the bombed center and their menstrual conditions. Cases who showed no disorder were only 113 (32.4%).

N.B. Classification of the menstrual types as follows:

Type I: No change
Type II: Complete amenorrhea directly after bombing
Type III: Amenorrhea after one regular menstruation
Type IV: Amenorrhea after two or more regular menstruations
Type V: Other pathologic cases, namely, ante or postponed menses, atypical bleeding, etc.

We classified the kinds of injuries into 4 groups, i.e.,

R - Radiation sickness, regardless of the existence of burn or mechanical wound
B - Burn, or burn with mechanical wound
I - Mechanical wound only
H - Entirely sound (no injury)

Table II shows the relation between the menstrual types and the kinds of injuries. A group of persons with the manifest symptoms of a radiation sickness, shows the less percentage of normal menstruation among them than groups of other kinds of injuries.

If we could presume that two or more menstruations at regular intervals after amenorrhea would be a proof of recovering, so 93 cases out of 113 examined cases might be said to have recovered before March 1946. Besides those cases we had 59 of Type I (no change) cases, there are in total 152 (86.2%) including recovery and (no change) cases among 172 examined cases. Moreover, as some pregnant women may be included in those apparently unrecovered cases, so the recovery of the sufferers seems to be comparatively quick and to be in favorite course. Actually 6 cases are pregnant. In short, many of survived sufferers seem to be castrated temporarily, but not to be given serious ovarian damage.

The relation between kinds of injuries and the type of menstrual abnormalities surveyed in March 1946 is shown in Table III.

The same investigations were tried on 20 cases which were in concrete buildings.

Even if they were at a distance between 0.5 and 2.0 km from the center, the rate of the damage is lower.

Eight of eleven abnormal cases have recovered (72.7%). Table IV shows the time of recovery, or the second month of appearing menstruation that repeats over two times at regular intervals.

As shown in Table V, originally irregular cases were 36 in total, 28 of these cases still remained irregular and 8 became regular. This fact should be due rather to the development of their daily life, comparing with that of the hard war-time than to the bombing effect. And it is remarkable that the recovery of full adults' group is more eminent than that of younger or older groups.

Before March 1946, seven among thirty cases of lactational amenorrhea had recovered, but we can induce nothing from these results. For about pregnancy, at the time of the bombing most of the pregnant women had already removed to the safe country-sides, and in the city they were so few that we could get but 72 cases. Table VI indicates the lunar months at that time, and Table VII the relation to the distance. The threatened abortion happened about 2 cases of them, but were safe in their progress. The cases of spontaneous abortions were 4, and artificial abortions 2. All other cases were normal and 18 of them have delivered without any particular hindrance throughout both the labor and puerperium, and for about the new borns, we have nothing to be noticed except the following three cases: a child died of asphyxia caused by breech presentation; two cases of 9th month's deliveries on the next day and in 2 weeks after bombing caused by diarrhea.

With the only one female autopsy case, we got nothing can be discussed about the pathologic changes of ovary. Nevertheless, by Dr. Miyake, ovary is observed atrophic in general, poor in primordial ovals, and the fall of membrana granulose of Graafian follicle is reported.

And by some cases in a recovery course, primordial ovals were said to be normal, but Graafian follicle to be yet atrophic.

Twenty-six relatively serious cases were examined gynecologically and found 2 slightly smaller uteri, 2 slightly bigger uteri, and 4 retroflexed uteri, these abnormal cases were 8 in total, and about the other 18 cases nothing pathologic was found. But those changes of the uteruses are not important and mean nothing. Test Abrasio mucasae was tried toward above mentioned 26 cases. One of them showed a tuberculous endometritis and its phase of menstrual cycle could not be defined. Sixteen of them showed post menstrual phases, 10 of these were in beginning stadium, 3 in middle stadium and 3 in end stadium of their phase. Four of 26 cases showed intermenstrual phase, 3 of these were in beginning stadium and one was in end stadium of their phase. Specimens of other 5 cases were so small that we could not define their phases.

As to the endometrium of 11 continuous amenorrhea cases, the estimated phase at the bombed time did not correspond to the actual phase shown by the specimens. Over half of them showed the beginning or middle stadium of post menstrual phase.

Endometrium itself was generally thin and atrophic.

On the recovery cases, the estimated phase and the phase diagnosed by specimens were well correspondent.

TABLE I

Relation between the menstrual types and the distance from the bombing center.

Type / Distance	Normal I (%)	II	III	Abnormal IV	V	Total of Abnormal Cases (%)	Total Cases
0.5	0	1	2	0	1	4(100.0)	4
0.6 -1.0	5(20.8)	11	4	2	2	19(79.2)	24
1.1 -1.5	21(24.7)	34	22	4	4	64(75.3)	65
1.6 -2.0	27(25.5)	39	26	5	9	79(74.5)	106
2.1 -2.5	32(40.5)	23	12	3	9	47(59.5)	79
2.6 -3.0	18(56.2)	8	1	2	3	14(43.8)	32
3.1 -3.5	4(57.1)	1	1	1	0	3(42.9)	7
3.6 -4.0	1	1	0	0	0	1	2
4.1 -4.5	1	0	1	0	0	1	2
4.6 -5.0	2	0	0	0	0	0	2
Totals	111(32.4)	118	69	17	28	232(67.6)	343

TABLE II

Relation between the Menstrual Type and the Kinds of Injuries

Type Kinds of Injuries	Normal (%) I	Abnormal II	III	IV	V	Totals of abnormal cases (%)	Total Cases
R	17(23.6)	25	17	6	7	55(76.4)	72
B	33(33.3)	27	23	4	12	66(66.7)	99
I	37(34.6)	42	18	4	6	70(65.4)	107
H	24(36.9)	24	11	3	3	41(63.1)	65
Totals	111(32.4)	118	69	17	28	232(67.6)	343

TABLE III

Relation between the Menstrual Type and the Kinds of Injuries

Type Kinds of Injuries	Normal (%) I	II	III	IV	V		Totals of Abnormal Cases (%)	Total Cases
R	6 (p)1	18(12) (p) 2	5(3)	3(3)	7(6)	33	24(72.7)	39 (p)3
B	20 (p)1	17(15) (p)1	15(13) (p)1	2(2)	9(8)	43	38(88.3)	63 (p)3
I	22	18(15)	4(2)		4(3)	26	20(77.0)	48
H	11	9(7)	4(2)		2(2)	15	11(73.3)	26
Totals	59	62(49)	28(20)	5(5)	22(19)	117	93	176(p)6

Regular numerals indicate the recovery cases by March 1946.

Numbers with a letter (p) indicate the pregnant cases.

TABLE IV

Times of Recoveries Concerning the Abnormal Cases

Distance	Sept.	Oct.		Nov.		Dec.		January		Feb.	March	Total Cases	
0.5 k.m.													
0.6 – 1.0	1	2	1*	1	1*	1	1*	1	1*			6	3*
		7										23	
1.1 – 1.5		*p. 1	2*	4	1*	4	1*	4	2*	4		*p 1	5*
		9		9								36	
1.6 – 2.0	2	*p. 2		*p 1		7		6		3		*p 3	
2.1 – 2.5	4	6		7		1		3		1		22	
2.6 – 3.0	1	1		2		2						6	
3.1 – 3.5													
3.6 – 4.0													
4.1 – 4.5													
4.5 – 5.0													
Totals	8	25 *p 3	3*	23 *p 1		15	2*	14	3*	8		93 *p 4	8*

* Figures in second column indicate the cases in concrete buildings.

* Numbers with a letter (p) indicate the conceptive cases after bombed.

TABLE V

Influence upon originally irregular cases

	Cases still remaining irregular	Cases becoming regular & recovering from amenorrhea	Total Cases
Adult (18-45th yr.)	16	7	23
Under 18th yr.	6	1	7
Advanced in age above 46th yr.	6	0	6
Totals	28	8	36

TABLE VI

Lunar months at time of bombing

Lunar mos.	Cases	
1st	4	2 spontaneous abortions, one in 3rd month, other in 4th month.
2nd	16	one artificial abortion in 6th month; 2 spontaneous abortions, one in 4th month, other in 5th.
3rd	16	one threatened abortion, but further pregnant safe.
4th	9	one artificial abortion in 8th month. Child showed no abnormality.
5th	4	one threatened abortion, but further pregnant safe.
6th	8	
7th	3	
8th	2	
9th	5	
10th	5	
Totals	72	

TABLE VII

Pregnant Cases Classified by Distance

Distance		Cases
0.5 km.	1	Threatened abortion, but was safe in further pregnancy.
0.6 - 1.0	2	
1.1 - 1.5	10	
1.6 - 2.0	16	One threatened abortion, but was safe in further pregnancy.
2.1 - 2.5	20	Two artificial abortions in 8th and 6th month. Two spontaneous abortions.
2.6 - 3.0	11	
3.1 - 3.5	1	
3.6 - 4.0	4	One spontaneous abortion.
4.1 - 5.0	3	
unknown	4	
S. Totals	72	

M O N T H L Y R E P O R T - September 1, 1946

The Works of the Medical Section of the Special Committee for the Investigation of the Effects of the Atomic Bomb, the National Research Council in Japan

(Dr. Masao Tsuzuki, ex-professor of the Tokyo Imperial University)

N. B. The Medical Section sent a note to the Joint Commission on June 25, 1946, concerning the following affairs:

1. The printing of the official report of the National Research Council in Japan.

2. The publication of the scientific reports of the Japanese investigators.

3. The further management of the Japanese Government Group.

Since no reply has yet been received, the monthly reports dated on July 1 and August 1 therefore were not presented.

I. The Field Works

1. An American party came and studied the after effects. Col. James Cooney, Capt. Douglas Wake, Lt. Melvin A. Block, USA, MC, and Lt. Edgar Snow, USNR, arrived Tokyo on August 10 from Bikini. Dr. Tsuzuki was asked to take care of them, to arrange for their study on the after effects of the atomic bomb at Hiroshima and Nagasaki. A special meeting was held on August 14 at Tokyo Imperial University, many Japanese doctors were present and had a round table talking on the atomic bomb effects.

The party made a one week trip to Hiroshima and Nagasaki. Dr. Tsuzuki accompanied and explained the general condition of both cities. They visited hospitals and studied patients who were treated on some sequelae, most of them were after effects of burns - contractures, keloids, etc. Capt. Wake and Lt. Block stayed in several days at both cities and studied; they made a special survey on the inhabitants of the Nishiyama district, Nagasaki, and confirmed there were still some cases of leucocytosis probably caused by the continuous radioactivity of the fallen fission fragments.

2. The medical party of the Kyoto Imperial University was sent to Hiroshima and made a survey on the after effects of the atomic bomb from August 19 to 31, 1946.

II. The Laboratory Works

1. The provisional official report of the Medical Section consists of 4 parts:

(1) Medical studies of the effects of the atomic bomb (a general view), by Dr. Masao Tsuzuki, Tokyo Imperial University.

(2) Clinics of the atomic bomb radiation sickness, by Dr. Kanshi Sassa, Tokyo Imperial University.

(3) Radioactivity of atomic bomb, from the medical point of view, by Dr. Masaneri Nakaizumi, Tokyo Imperial University.

(4) Patho-anatomical studies on the atomic bomb cases, by Dr. Ryojun Kinoshita, Osaka Imperial University, and Dr. Masachi Miyake, Tokyo Imperial University.

2. The provisional official report is now finished and going to deliver among the principal members of the Medical Section. In October the staff meeting will be held and discuss the report thoroughly again. The final official report will be prepared then.

III. The Reports which are finished and presented to the Joint Commission through Capt. D. Wake, who will leave Tokyo for Washington on September 10.

1. Case reports of patients caused by the atomic bomb: by Dr. K. Nakagawa. Dermato-Urological Clinic, Kyoto Medical College.

2. Report of the Patho-anatomical studies on the subacute atomic bomb cases at Nagasaki, by Dr. T. Yamori, Yamaguchi Medical School.

3. Additional report on the pathologic anatomic changes in the atomic bomb disease, by Dr. K. Ono and Dr. T. Imai, Kyushu Imp. Univ.

4. The influence of the atomic bomb upon the functions of the female genital organs, by Dr. S. Mitani and others, Tokyo Imp. Univ.

5. Report on the medical studies of the effects of the atomic bomb (one part of the provisional official report of the Medical Section), by Dr. M. Tsuzuki, Tokyo Imp. Univ.

APPENDIX NO. 3

J A P A N E S E M A N U S C R I P T S

Available As Of 2 January 1947

SOURCES

National Research Council	3
Japanese Army	1
Japanese Navy	4
Tokyo Imperial University	46
Kyoto Imperial University	15
Kyushu Imperial University	20
Osaka Imperial University	5
Nagaya Imperial University	1
Kyoto Pref Med College	3
Okayama Med College	1
Nagasaki Med College	7
Kumamoto Med College	1
Osaka Med School	1
Osaka Womens Med School	1
Yamaguchi Med School	3
Hiroshima Sanatorium	1
Railroad Hospitals	4
Others	2
TOTAL	119

DISTRIBUTION OF STUDIES

Category	Papers
Organizational	1-3
General	4-13
Medical	14-83
Path-Anatomical	84-90
Hematological, Blood-Chemistry	91-103
Reproductive	104-107
Capillaries, Skin	108-111
Autopsy	112
Children	113
Bacteriology, Serology	114-116
Radiation	117-119

ORGANIZATIONAL:

1. Report (shorthanded) of the first general meeting (30 Nov 45)
   The Special Committee for the Investigation of the Effects of the Atomic Bomb
   National Research Council of Japan

2. Report (shorthanded) of the second general meeting (28 Feb 46)
   The Special Committee for the Investigation of the Effects of the Atomic Bomb
   National Research Council of Japan

3. Preliminary outlines of the results of the investigations
   The Special Committee for the Investigation of the Effects of the Atomic Bomb
   National Research Council of Japan

GENERAL:

4. Reports of the inspection of the cave-trenches around the hill of prison in the city of Nagasaki
   URABE, Miyoshi (Surg), OHASHI, Shigeru (Pharm), UEDA, Hideo (Int Med), HAKAMADA, Saburo (Psych) and NIKAIDO, Soshiro (Phys Therap)
   Faculty of Medicine, Tokyo Imperial University

5. Reports of the inspection of the casualties in the buildings of Shiroyama Public School at Nagasaki
   URABE, Miyoshi (Surg), OHASHI, Shigeru (Pharm), UEDA, Hideo (Int Med), HAKAMADA, Saburo (Psych) and NIKAIDO, Soshiro (Phys Therap)
   Faculty of Medicine, Tokyo Imperial University

6. Reports of the inspection of the casualties in the buildings of Fuchi Public School at Nagasaki
   URABE, Miyoshi (Surg), OHASHI, Shigeru (Pharm), UEDA, Hideo (Int Med), HAKAMADA, Saburo (Psych) and NIKAIDO, Sochiro (Phys Therap)
   Faculty of Medicine, Tokyo Imperial University

7. Remarkable facts of the atomized patients at Hiroshima
   KUWABARA, Satoru
   Surg Clinic (Dr. Otsuki), Faculty of Medicine, Tokyo Imperial University

8. Contribution to the problem of the causes of deaths of the atomic bomb victims
   KASHIWADO, Teiichi
   Oto-Rhino-Laryng Clinic (Dr. Masuda), Faculty of Medicine, Tokyo Imperial University

9. The human damages by the atomic bomb in a building at 200 meters from the ground center
   KITAMOTO, Osamu (med clinic-Dr. Sakaguchi) and ISHIKAWA, Koichi (surg clinic-Dr. Otsuki)
   Faculty of Medicine, Tokyo Imperial University

10. Survey on the human damages in the typical strong constructed buildings at Hiroshima
MURATI, Koiti, and MURAI, Takeo
Institute of the Physical and Chemical Research - Faculty of Medicine, Tokyo Imperial University

11. Relations between the human damages and substances of the shelters at Hiroshima
MURATI, Koiti, and MURAI, Takeo
Institute of the Physical and Chemical Research - Faculty of Medicine, Tokyo Imperial University

12. Survey of the radioactive influence by the atomic bomb which was used at Nagasaki, upon the inhabitants in the district of Chijiwa Town
KATSUKI, Shimenosuke (Assistant Professor Int Med) & others
Medical Clinic (Dr. Kusunoki), Faculty of Medicine, Kyushu Imperial University

13. Reports of the inspection of the casualties in the buildings of CHINZEI Middle School at Nagasaki
URABE, Miyoshi (Surg), OHASHI, Shigeru (Pharm), UEDA, Hideo (Int Med), HAKAMADA, Saburo (Psych), and NIKAIDO, Soshiro (Phys Therap)

MEDICAL:

14. Medical report of atomic bombing in Hiroshima Army Medical School and The First Tokyo Army Hospital Japanese Army

15. a) Survey of the atomic bomb at Hiroshima (general aspects)
b) Survey of the atomic bomb at Hiroshima (medical aspects)
KURE Naval Station
Japanese Navy

16. Studies on the biological action of the atomic bomb (the second report)
KURE Naval Station, Medical Department
Japanese Navy

17. Studies on the biological action of the atomic bomb (the third report)
KURE Naval Station, Medical Department
Japanese Navy

18. Studies on the biological action of the atomic bomb (the fourth report)
KURE Naval Station, Medical Department
Japanese Navy

19. On cachectic condition of the atomic bomb patients at Nagasaki
URABE, Miyoshi, and MENJO, Matsutoshi
Surg Clinic (Dr. Tsuzuki), Faculty of Medicine, Tokyo Imperial University

20. Gastro-intestinal tract, the TAKATA tests and urine examination of the atomic bomb patients at Nagasaki
KISHIMOTO, Katsumi
Medical Clinic (Dr. Sassa), Faculty of Medicine, Tokyo Imperial University

21. Clinical observations of the atomic bomb patients at Hiroshima (the first report)
NAKAO, Kiku and others
Medical Clinic (Dr. Sassa), Faculty of Medicine, Tokyo Imperial University

22. The report of the influence of the atomic bomb explosion on the ear, nose, and throat. (the 1st, 2nd, 3rd, and 4th reports)
KASHIWADO, Teiichi
Oto-Rhino-Laryng Clinic (Dr. Masuda), Faculty of Medicine, Tokyo Imperial University

23. Some clinical studies upon the atomic bomb patients at Nagasaki, in the Omura Naval Hospital
YAMAMURA, Hideo
Surg Clinic (Dr. Otsuki), Faculty of Medicine, Tokyo Imperial University

24. The investigation of oral disease of the atomic bomb patients at Hiroshima
AKIYAMA, Taichiro
Dental Clinic (Dr. Kanamori), Faculty of Medicine, Tokyo Imperial University

25. Stochastic studies on the atomic bomb casualties at Hiroshima. Comparison of the death rate of male with that of female.
MASUYAMA, Motosaburo, Ph. D.
Faculty of Medicine, Tokyo Imperial University and Institute for the Statistical and Mathematical Studies, Educational Ministry

26. Stochastic studies on the atomic bomb casualties at Nagasaki. Death rate date curve
MASUYAMA, Motosaburo, Ph. D.
Faculty of Medicine, Tokyo Imperial University and Institute for the Statistical and Mathematical Studies, Educational Ministry

27. Stochastic studies on the atomic bomb casualties at Hiroshima. Death rate date curve
MASUYAMA, Motosaburo, Ph. D.
Faculty of Medicine, Tokyo Imperial University and Institute for the Statistical and Mathematical Studies, Educational Ministry

28. Stochastic studies on the atomic bomb casualties at Hiroshima. Death rate distance curve
MASUYAMA, Motosaburo, Ph. D.
Faculty of Medicine, Tokyo Imperial University and Institute for the Statistical and Mathematical Studies, Educational Ministry

29. Clinical researches of ocular affections caused by atomic bomb explosion at Hiroshima
SHOJI, Yoshiharu (Prof. Ophth) and FUKUOKA, Tsunemasa, NITTA, Tadashi
Ophth Clinic (Dr. Shoji), Faculty of Medicine, Tokyo Imperial University

30. On the brains of the atomic bomb victims
OKADA, Keizo, SHIMAZONO, Yasuo, and NAKAMADA, Saburo
Psychiatric Clinic (Dr. Uchimura), Faculty of Medicine, Tokyo Imperial University

31. Atomic bomb effects and tuberculosis of the chest
KITAMOTO, Osamu, AYUKAWA, Sensai, and others
Medical Clinic (Dr. Sakaguchi), Faculty of Medicine, Tokyo Imperial University

32. Some statistics of fevers, fatigue feelings and complications of the radiation sickness
KITAMOTO, Osamu and others
Medical Clinic (Dr. Sakaguchi), Faculty of Medicine, Tokyo Imperial University

33. On the fever of the atomic bomb patients at Hiroshima
KUBO, Ikuya and KITAMOTO, Osamu
Medical Clinic (Dr. Sakaguchi), Faculty of Medicine, Tokyo Imperial University

34. Disturbances of the function of liver of the atomic bomb patients
FUKUDA, Tamotsu (Ass't Prof of Surgery) and WATANABE, Toshie
Surg Dept, the Branch Hospital, Faculty of Medicine, Tokyo Imperial University

35. Disturbances of the function of liver and capillary of the atomic bomb patients
KOBAYASHI, Tachio and others
Medical Clinic (Dr. Sassa), Faculty of Medicine, Tokyo Imperial University

36. The clinical investigation of the atomic bomb disease
SAWADA, Toichire (Prof Int Med) and others
Medical Clinic (Dr. Sawada), Faculty of Medicine, Kyushu Imperial University

37. Report of the investigation of the atomic bomb casualties at Hiroshima, surveyed in October and November, 1945
Medical Parties, Tokyo Imperial University
Faculty of Medicine, Tokyo Imperial University

38. Timely distribution of the symptoms of radiation sickness at Nagasaki and the blood pictures after the second month
UEDA, Hideo (Med Clinic-Dr. Sassa) and NIKAIDO, Soshiro (Institute of the Med Physical Therapy)
Faculty of Medicine, Tokyo Imperial University

39. Contribution to the cachectic condition of the atomic bomb patients at Nagasaki
URABE, Miyoshi and MENJO, Matsutochi
Surg Clinic (Dr. Tsuzuki), Faculty of Medicine, Tokyo Imperial University

40. Change of the gastric intestinal organ by the atomic bomb injury
KOGA, Hideo (Ass't Prof Surg) and others
Surg Clinic (Dr. Tomoda), Faculty of Medicine, Kyushu Imperial University

41. On the lesion of the pharynx and the larynx by atomic bomb
SASAKI, Minoru (Prof. Oto-R-Laryng) and others
Oto-Rhino-Laryngological Clinic, Faculty of Medicine, Kyushu Imperial University

42. The injuries of the eyes by the atomic bomb (clinical observation).
TAMURA, Shigemi (Prof. Ophth), and others
Ophth Clinic, Faculty of Medicine, Kyushu Imperial University

43. On the atomic injury and the function of liver
KIRAO, Kenichi (Ass't Prof. Surg)
Surg Clinic (Dr. Ishiyama), Faculty of Medicine, Kyushu Imperial University

44. Case reports on the atomic bomb patients at Hiroshima and Nagasaki
Pediatric Clinic
Kyoto Prefectural Medical College

45. Report on the atomic bomb patients
KURUSU, Masao
Surg Clinic (Dr. Mochizuki), Kyoto Prefectural Medical College

46. Report on the atomic bomb patients at Nagasaki
KAMEDA, Sakisuke (Ass't Prof. Radiol)
Department of Radiology, Kumamoto Medical College

47. On the late radiation sickness, caused by the atomic bomb
YAMAZAKI, Shunzo (Prof. Oto-R-Laryng)
Oto-Rhino-Laryngological Clinic, Osaka Medical School

48. On the injured patients by the atomic bomb
SAITO, Makoto (Prof. Surg)
Surg Clinic (Dr. Saito), Faculty of Medicine, Nagoya Imperial University

49. Oto-rhino-laryngological findings by the atomic bomb effect
TAKAHARA, Takazo (Prof Oto-R-Laryng)
Oto-Rhino-Laryngological Clinic, Osaka Womens Medical School

50. Report of the atomic bomb cases (Summary)
OZAWA, Masaji (Prof. Int Med)
Medical Clinic, Yamaguchi Medical School

51. My experience of the "atomic bomb disease"
MONDEN, Yoshinobu, Student
Yamaguchi Medical School

52. The effects of the atomic bomb on the human beings at Hiroshima
FUJII, Minoru and others
Hiroshima Sanatorium, Saijo, Hiroshima Prefecture

53. Survey of the members of the railroad service at Hiroshima
MATSUFUJI, Gen and others
Laboratory for the scientific research of physical and labour affairs, Railroad Bureau, Ministry of Communication

54. Report on the medical studies of the effects of the atomic bomb (one part of the provisional official report of the Medical Section, Special Committee, National Research Council of Japan)
TSUZUKI, Masao (Prof. Surg)
Surg Clinic (Dr. Tsuzuki), Faculty of Medicine, Tokyo Imperial University

55. Case reports of the atomic bomb patients
OKUTANI, Hiromitsu
Moji Railroad Hospital

56. Clinical research for the atomic bomb injury, with special reference to the functional disturbance of the adrenal glands, the liver, and the cause of the blister-formation on the skin (preliminary report)
INOUYE, Katashi (Prof. Int Med) and others
Medical Clinic (Dr. Inouye), Faculty of Medicine, Kyoto Imperial Univ.

57. Case reports of the atomic bomb disease
HOSHI, Jiro
Kawakita Hospital, Tokyo

58. Case reports on patients caused by atom bomb, Part 1.
NAKAGAWA, Kiyoshi (Prof. Derm)
Dermato-urological Clinic, Kyoto Prefectural Medical College

59. Report of the physical examination of the members of the railroad service at Nagasaki
YOSHIMURA, Saburo and others
Nagasaki Administration Bureau, Railroad Bureau and Moji Railroad Hospital

60. Distribution of the symptoms of the atomic bomb patients at Nagasaki
OHASHI, Shigeru (Pharma), UNABE, Miyoshi (Surg), UEDA, Hideo (Int Med), HAKAMADA, Saburo (Psychiat) and NIKAIDO, Soshiro (Phys Therapy)
Faculty of Medicine, Tokyo Imperial University

61. The research on atomic bomb victims, with 26 tables
KUSUNOKI, Goroo (Prof. Int Med)
Med Clinic (Dr. Kusuanoki), Faculty of Med, Kyushu Imperial Univ.

62. The report of hygienic investigation with regard to the continuous actions of damage in consequence of the atomic bombing at Nagasaki
OTSUBO, Kiyomi (Prof. Hyg) and ISHIZAWA, Shoichi
Institute of Hygiene, Faculty of Medicine, Kyushu Imperial University

63. Clinical Observation of the atomic bomb disease
MISAO, Tando (Prof. Int Med) and others
Medical Clinic (Dr. Misao), Kyushu Imperial University

64. Investigation of injuring effect upon the human body by the explosion of atomic bomb at Nagasaki City
NAKAJIMA, Ryotei (Prof. of Radiology), ISHIKAWA, Kazuo (Ass't Prof.) and others
Department of Radiology (Dr. Nakajima), Faculty of Medicine, Kyushu Imperial University

65. Medical effect of atomic bomb
FUSE, Nobuyoshi (Prof. Int Med)
Medical Clinic (Dr. Fuse), Faculty of Med, Osaka Imperial University

66. The relation between flash burn and radiation sickness by the atomic bomb
YASUOKA, Shizo and TOMIHARA, Masakazu
Physical Therapy Dept. (Dr. Nagahashi), Faculty of Medicine, Osaka Imperial University

67. Report on the atomic bomb thrown on Hiroshima
ASADA, Tsunesaburo (Prof. Physics) and others
Department of Physics, Faculty of Science, Osaka Imperial University

68. Data of the statistical surveys of the casualties by the atomic bomb at Nagasaki
SHIRABE, Raisuke (Prof. Surg)
Surg Clinic (Dr. Shirabe), Nagasaki Medical College

69. The situation of peoples in Nagasaki Medical College on the 9th August 1945
KOYANO, Kohei, Dean of the Nagasaki Medical College
Nagasaki Medical College

70. Liver function tests on the atomic bomb patients at Nagasaki (Santonic acid sodium load tests and Takata-Ara tests)
OKURA, Ichiro
Medical Clinic (Dr. Tsuno), Nagasaki Medical College

71. Santonin test on the liver function of the atomic bomb patients at Nagasaki
OKURA, Ichiro
Medical Clinic (Dr. Tsuno), Nagasaki Medical College

72. Memoranda on the self-experience of the atomic bombing as a medical man
Members of the Nagasaki Medical College
Nagasaki Medical College

73. Survey of the radioactive influence caused by the atomic bomb which was used at Nagasaki, upon the inhabitants in the city of Shimabara
OSAJIMA, Shiro (Ass't Prof. Int Med) and KO, Eicho
Medical Clinic (Dr. Tsuno), Nagasaki Medical College

74. Clinic of the so-called radiation sickness, surveyed at Nagasaki
KIKUCHI, Takehiko (Prof. Int Med)
Medical Clinic (Dr. Kikuchi), Faculty of Medicine, Kyoto Imperial University

75. On the cerebrospinal fluid of the atomic bomb patients
NAITO, Yukio
Medical Clinic (Dr. Mashimo-Dr. Mayekawa), Faculty of Medicine, Kyoto Imperial University

76. Electrocardiograms of the atomic bomb patients
SHIMIZU, Saburo and others
Medical Clinic (Dr. Mashimo-Dr. Mayekawa), Faculty of Medicine, Kyoto Imperial University

77. Report on the atomic bomb effect at Nagasaki
Pathological Institute
Faculty of Medicine, Kyoto Imperial University

78. Oral findings of the atomic bomb patients
MINOGUCHI, Izuru
Faculty of Medicine, Kyoto Imperial University

79. A preliminary report on the disaster in Hiroshima City caused by the atomic bomb
Research Commission of the Kyoto Imperial University
Kyoto Imperial University

80. Clinic of the so-called radiation sickness, surveyed at Hiroshima
KIKUCHI, Takehiko (Prof. Int Med)
Medical Clinic (Dr. Kikuchi), Faculty of Medicine, Kyoto Imperial University

81. Preliminary report of the damages on structures due to the atomic bomb
KONDO, Yasuo (Prof Civil Eng)
Civil Engineering Department, Faculty of Engineering, Kyoto Imperial University

82. On the influence of the atomic bomb in Hiroshima on August 6, 1945
IMAMURA, Shun-ichiro (Ass't Prof. Applied Botany), FUJITA, Tetsuo (Prof. Botany, Hiroshima Higher Normal School)
Faculty of Science, Kyoto Imperial University

83. Surveys on malnutrition of the atomic bomb patients at Hiroshima
KUBO, Ikuya
Medical Clinic (Dr. Sakaguchi), Faculty of Medicine, Tokyo Imperial University

PATH-ANATOMICAL:

84. Path-anatomical Studies on 34 atomic bomb cases at the city of Hiroshima and Nagasaki (The first report)
MIYAKE, Masashi (Ass't Prof. Path)
Pathological Institute, Faculty of Medicine, Tokyo Imperial University

85. Preliminary report on the path-anatomical studies of the atomic bomb cases in the city of Hiroshima
MIYAKE, Masashi (Ass't Prof. Path)
Pathological Institute, Faculty of Medicine, Tokyo Imperial University

86. Clinical and path-anatomical studies on the scar tissues after the atomic bomb burns
KAJITANI, Tamaki and ISHIBASHI, Yukio
Surg Clinic (Dr. Tsuzuki), Faculty of Medicine, Tokyo Imperial University

87. Report of the path-anatomical studies on the subacute atomic bomb cases at Nagasaki
YAMORI, Takeo (Prof Path)
Pathological Institute, Yamaguchi Medical School

88. Influence of atomic bomb upon the growing zone of the bone
KINNAKA, Seiichi (Prof. Orthop Surg) and others
Orthopedic Clinic (Dr. Kinnaka), Faculty of Medicine, Kyushu Imperial University

89. Additional report on the pathologic anatomic changes in the atomic bomb disease
ONO, Kosaku (Prof. Path), IMAI, Tamaki and others
Pathological Institute, Faculty of Medicine, Kyushu Imperial University

90. On the pathologic anatomic changes in the atomic bomb disease
ONO, Kosaku (Prof. Path), IMAI, Tamaki and others
Pathological Institute, Faculty of Medicine, Kyushu Imperial University

HEMATOLOGICAL - BLOOD-CHEMISTRY:

91. Attitude of the eosinophile cells in the blood and bone marrow of the patients at Nagasaki, in the 3rd and 4th months
UEDA, Hideo (Med Clinic-Dr. Sassa) and NIKAIDO, Soshiro (Dept of Med Phys Therapy - Dr. Misawa)
Faculty of Medicine, Tokyo Imperial University

92. Chloride content of blood of the atomic bomb patients in Omura Naval Hospital
HINO, Sadao
Medical Clinic (Dr. Sassa), Faculty of Medicine, Tokyo Imperial University

93. Statistical observation of the peripheral blood pictures of the atomic bomb patients in the 3rd and 4th months
NAKAO, Kiku, OKOSHI, Masaaki, KAKEHI, Koki, TSUKADA, Toru, KATO, Shuichi, and KAWAMURA, Motoi
Medical Clinic, Faculty of Medicine, Tokyo Imperial University

94. Hematological study on the atomic bomb disease
NAKAO, Kiku, KOBAYASHI, Tachio and others
Medical Clinic (Dr. Sassa), Faculty of Medicine, Tokyo Imperial University

95. Report of the atomic bomb patients at Hiroshima (The first report), blood protein and sperma
ASAKURA, Takeshi
Surg Clinic (Dr. Otsuki), Faculty of Medicine, Tokyo Imperial University

96. Report of the atomic bomb patients at Hiroshima (The second report), sperma pictures and blood pictures in the 6th month
ASAKURA, Takeshi
Surg Clinic (Dr. Otsuki), Faculty of Medicine, Tokyo Imperial University

97. Atomic bomb effect on white blood corpuscles
NISHIMARU, Kazuyoshi and others
Jikei Service Corporation, Tokyo and Shohara - machi Red Cross Hospital, Hiroshima Prefecture

98. On the biochemical and physicochemical changes of the blood of the atomic bomb patients
FUNAOKA, Shogo (Prof. Anat) and others
Anatomical Institute, Faculty of Medicine, Kyoto Imperial University

99. On some chemical constituents of the blood of the atomic bomb patients (a provisional report)
HIROHATA, Ryozo (Prof. Biochem) and others
Institute of Biochemistry, Faculty of Medicine, Kyushu Imperial University

100. Study of the sternal punctate of the radiation disease (Preliminary report - abstract)
MASUYA, Tomiichi
Medical Clinic (Dr. Sawada), Faculty of Medicine, Kyushu Imperial University

101. On a case of monocyte leukemia, occurred after the "atomic bomb disease"
MISAO, Tando (Prof. Int Med), HARADA, Yoshimichi and HATTORI, Junichi
Medical Clinic (Dr. Misao), Faculty of Medicine, Kyushu Imperial University

102. The picture of blood and bone marrow of the patients injured by atomic bomb
FUKUSHIMA, Kanshi (Prof. Int Med)
Medical Clinic (Dr. Fukushima), Faculty of Medicine, Osaka Imperial University

103. Hematological observations on 3 patients injured by the atomic bomb, "about the regenerative blood pictures and the influence of the blood transfusion upon them"
TSUDA, Yasushi and ADACHI, Susumu
Surg Clinic (Dr. Aoyagi), Faculty of Medicine, Kyoto Imperial University

REPRODUCTIVE:

104. Influence of the atomic bomb upon the secual function of the females (an intermediate report)
MITANI, Yasushi (Ass't Prof. Gynecol & Obstetrics) & ITO, Mitsuo
Gynecol & Obst Clinic (Dr. Shiraki), Faculty of Med, Tokyo Imperial University

105. Atomic bomb influence upon human sperma
SIMIZ, Kentaro (Ass't Prof. Surg)
Surg Clinic (Dr. Otsuki), Faculty of Medicine, Tokyo Imperial University

106. Relation between the atomic bomb effects and menstruation
HATANAKA, Toshiro
Moji Railroad Hospital

107. On the sperma of the atomic bomb patients at Hiroshima
OKOSHI, Masaaki (Urology), ASAKURA, Takeshi (Surg) and KASEKI, Tatsuo (Gynecology)

CAPILLARIES - SKIN:

108. Resistance of the skin capillaries and their micrograms of the atomic bomb patients at Hiroshima
AYUKAWA, Sensai and others
Medical Clinic (Dr. Sakaguchi), Faculty of Medicine, Tokyo Imperial University

109. Dermatological view on the lesions through the atomic bomb explosion
MINAMI, Shogo (Prof. Derm) and others
Dermatological Clinic, Faculty of Medicine, Kyushu Imperial University

110. Shortening of the resorption time of a pumphus of the skin of the atomic bomb patients
ICHINOSE, Kengo (Ass't Prof. Derm) and others
Dermatological Clinic (Dr. Kitamura), Nagasaki Medical College

111. Studies on the skin capillaries of the atomic bomb patients
TOMITA, Ken-nosuke and others
Medical Clinic (Dr. Mashimo-Dr. Mayekawa), Faculty of Medicine, Kyoto Imperial University

AUTOPSY:

112. Autopsy records of 28 atomic bomb cases at Hiroshima
MIYAKE, Masashi (Ass't Prof. Path) and others
Pathological Institute, Faculty of Medicine, Tokyo Imperial University

CHILDREN:

113. Atomic bomb disease in the childhood
ENJOHJI, Munenori (Prof. Pediatrics) and others
Pediatric Clinic, Faculty of Med, Kyushu Imperial University

BACTERIOLOGY - SEROLOGY:

114. The bacteriological and serological researches for diarrhea of atomic bomb disease
ENJOHJI, Munenori (Prof. Pediatrics) and others
Pediatric Clinic, Faculty of Medicine, Kyushu Imperial University

115. Active SH-base of serum protein of the atomic bomb patients
HAMAMOTO, Eiji, and YAMANOUCHI, Itsuro
Pediatric Clinic, Okayama Medical College

116. Bacteriological researches on the serum of patients who were injured by the atomic bomb at Nagasaki
KIMURA, Ren (Prof. Microbiology) and others
Microbiological Institute, Faculty of Medicine, Kyoto Imperial University

RADIATION:

117. Radioactivity of the ground at Nagasaki and its neighborhood
SHINOHARA, Kenichi (Prof. Physics) and 5 others
Department of Physics, Faculty of Science, Kyushu Imperial University

118. Researches on the radioactivity at Hiroshima
ITO, Junkichi (Prof. Physics) and others
Department of Physics, Faculty of Science, Osaka Imperial University

119. The field observation at Hiroshima on the radioactivity induced by atomic bomb
ARAKATSU, Bunsaku (Prof. Nuclear Physics) and others
Institute of Nuclear Physics, Faculty of Science, Kyoto Imperial University

APPENDIX NO. 4

JAPANESE PLANS FOR PUBLICATION OF THEIR REPORTS

OFFICIAL REPORT OF THE MEDICAL SECTION

THE SPECIAL COMMITTEE FOR THE INVESTIGATION OF THE

ATOMIC BOMB

THE NATIONAL RESEARCH COUNCIL OF JAPAN

(2 January 1947)

by

Dr. Masao Tsuzuki

OFFICIAL REPORT OF THE MEDICAL SECTION (CHAIRMAN: DR. MASAO TSUZUKI) THE SPECIAL COMMITTEE FOR THE INVESTIGATION OF THE EFFECTS OF THE ATOMIC BOMB, THE NATIONAL RESEARCH COUNCIL OF JAPAN (2 January 1947)

P A R T 1.

REPORT OF THE MEDICAL STUDIES OF THE EFFECTS OF THE ATOMIC BOMB.

Edited by Dr. Masao Tsuzuki, Professor of the Tokyo Imperial University.

A summarized report of the Medical Section, based on the various reports which have been presented by the medical investigators in Japan by February 28, 1946. Scientific reports of each survey team and investigator, dealing with special features, will be presented separately.

CONTENTS

Chapter I. Injurious effects of the explosion of the atomic bomb upon the human body.
- 1) Thermal energy and its injurious effects.
- 2) Mechanical energy and its injurious effects.
- 3) Radioactive energy and its injurious effects.
- 4) The atomic bomb injury.

Chapter II. Clinical course of the atomic bomb injuries.
- 1) The first period (the early stage).
- 2) The second period (the middle stage).
- 3) The third period (the late stage).
- 4) The fourth period (the after stage).

Chapter III. Damage and casualties caused by the atomic bomb.
- 1) Damage to the cities.
- 2) Statistics of the sufferers.
- 3) Statistics of casualties in special groups.
- 4) General view of the atomic bomb injuries.

Chapter IV. Problems of contamination of the bombed area.
- 1) Influence by fission fragments.
- 2) Influence by induced radioactivity.
- 3) Influence by poisonous substances.
- 4) Contaminated condition of the bombed area.

Chapter V. Protection and rescue problems against the atomic bomb.
- 1) Protective measures.
- 2) Rescue measures.

Addendum: List of the reports on the medical studies, presented by February 28, 1946.

P A R T 2.

CLINIC OF THE ATOMIC BOMB RADIATION SICKNESS.

Edited by Dr. Kanshi Sassa, Professor of the Tokyo Imperial University.

A report of the Radiation Sickness Team, the Medical Section, the Special Committee for the Investigation of the Effects of the Atomic Bomb.

CONTENTS

1. Introduction.
2. Etiological items.
3. Outlines of the clinical pictures.
4. General Symptoms.
5. Oral cavity.
6. Hematology.
7. Hemorrhage.
8. Digestive organs.
9. Circulatory organs.
10. Respiratory organs.
11. Urine.
12. Nervous systems.
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P A R T 3.

THE RADIOACTIVITY OF THE ATOMIC BOMB FROM THE MEDICAL POINT OF VIEW.

Edited by Dr. Masanori Nakaidzumi, Professor of the Tokyo Imperial University.

A report of the Radioactivity Team, the Medical Section, the Special Committee for the Investigation of the Effects of the Atomic Bomb.

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P A R T 4.

PATHOLOGY OF THE ATOMIC BOMB INJURIES.

Edited by Dr. Ryojun Kinoshita, Professor of the Osaka Imperial University and Dr. Masashi Miyake, Assistant Professor of the Tokyo Imperial University.

A report of the Pathology Team, The Medical Section, the Special Committee for the Investigation of the Effects of the Atomic Bomb.

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APPENDIX NO. 5

CONSIDERATIONS IN THE STUDY OF BURNS

SEQUELAE IN ATOMIC BOMB SURVIVORS

by

Melvin A . Block

1st Lt., M.C., A.U.S.

CONSIDERATIONS IN THE STUDY OF BURN SEQUELAE IN ATOMIC BOMB SURVIVORS

BY

LT. MELVIN A. BLOCK

I. Introduction

Members of the Commission have been impressed during their observations of atomic bomb survivors by the fact that many of the burns have healed with accumulations of large amounts of elevated scar tissue--the so-called keloids. Considerations pertaining to this problem and plans for the study during the next two months are here discussed.

II. Present gross appearance of the burned areas

The burned areas are largely limited to exposed regions of skin and were flash burns as described in reports dealing with early studies on atomic bomb casualties. Nearly all of these are now completely healed. Ulcerated areas are still seen in burn scars of an occasional individual, such areas being located at points of stress as contractures or in scarred areas receiving a poor blood supply or where edema is relatively prominent as at ankle areas.

The scarred areas vary greatly in appearance. A few are composed of rather thin atrophic depigmented scar tissue. In others the scar tissue is extremely thick and elevated above the surface of surrounding skin. The vascularity as noted by gross observation varies much. Some, especially those located on the face, are pink in color, more elastic to pressure, and warmer to touch than surrounding normal skin. These are thought to represent a comparatively early stage in development of scar tissue--the vascularity and cellularity being more prominent than in later stages. Other areas appear white or brown in color, are firm to touch, and are the same temperature to touch as surrounding skin tissue. These are thought to be a later stage in the series of alterations that occur in scar tissue--vascularity and cellularity presumed to have decreased while hyaline connective tissue composition increased. Between these two stages are many intermediate stages according to gross appearance. The surfaces of a few burns are still marked by crusting. Dilated blood vessels are visible on the surfaces of some. Many contractures are seen at locations where these usually occur.

Pigmentary changes are still evident, but the intensity of the hyperpigmentation previously observed on the exposed skin surfaces has apparently decreased much and in some cases has practically disappeared. Some scarred areas, especially those on the hands and feet, are characterized by complete depigmentation centrally.

Skin grafts of all types have been used where contractures or "keloids" have been excised. Nothing unusual is noted in these other than that in some cases where grafts were applied at locations where "keloids" had been excised, elevated masses of scar tissue recurred. Members of the Commission were impressed by the fact, however, that "keloids" have

occurred in donor sites on a few patients on whom skin grafts were placed at locations where "keloids" secondary to atomic bomb burns had occurred.

The striking feature noted is the large number of burns that have healed with excessive quantities of scar tissue, having a relatively flat surface elevated above that of surrounding skin. Margins of these lesions are sharply defined. The area involved varies very much, some being as small as one centimeter in diameter while others may involve most of the face or the back. The maximum growth of such tissue evidently was reached about eight to ten months following the injury. None seem to be enlarging in size now. Their appearance varies also as described in the above paragraphs. The bulk of the scar tissue also varies much in these cases. These are the so-called keloids. In some cases a burn involving only a few centimeters diameter apparently occurred, yet a keloid-like scar has resulted within the limits of this area with sharply defined edges separating it from normal appearing surrounding skin. Many individuals with such keloid formation complained much of hyperesthesis and paresthesias in the areas. However, these symptoms have decreased with time and changes in the scar tissue.

Several questions have arisen regarding these so-called keloids.

1. Is the apparently high incidence of keloids in these individuals to be expected considering the severity of the burns and the etiology?

2. Was the incidence of keloid formation increased as a result of poor treatment, delayed healing, infection, and the poor general condition of the survivors of the atomic bombings?

3. Was there any other factor operating in the cause or course of healing of the burns to result in greater accumulation of scar tissue (keloids)?

An attempt to answer such questions requires a complete clinical and laboratory study of a group of the survivors in addition to a similar study of a control group of Japanese individuals who sustained burns of other etiology. It may be found desirable to continue these observations at intervals throughout the lifetime of individuals who sustained flash burns.

III. Plans for the interim study of the problem

1. Objectives

a. Examine, question, photograph a group of atomic bomb survivors to obtain a cross-section view of the appearance of burned areas as they now appear.

b. To obtain specimens of excised scar tissue on a large group of survivors (75 to 100) for microscopic study.

c. To obtain as much similar information on a control group of Japanese who suffered burns of other etiology during the past several years.

d. To obtain information on the subject now available in the Japanese literature.

e. All work is to be done as a joint undertaking with Japanese physicians now working on the problem.

2. Details of methods of study

It would seem best to work on a basis of cooperation with Japanese physicians now studying the problem. Therefore, it is planned to first contact Dr. Masao Tsuzuki, chairman of the Committee for the Study of Medical Effects of the Atomic Bomb of the Japanese Research Council, to discuss and formulate more detailed plans and methods.

The next step planned is to work with Dr. Tsuzuki and members of the Faculty of Medicine, Tokyo Imperial University, who have been working on this problem in obtaining information now available regarding the incidence of keloids in Japanese, especially following burns, incidence of neoplastic changes in such lesions, and any other pertinent information.

The period of time to the middle of January, 1947 is to be spent in study of patients at the First and Second National Hospitals in Tokyo examining, questioning, photographing and obtaining specimens of excised scar tissue on individuals who sustained burns from other causes than the atomic bomb during the past several years. It is desired that this work be done with Japanese physicians of the Tokyo Imperial University Faculty of Medicine.

A visit to Hiroshima is contemplated for the middle of January, 1947. Similar work would be done then at the Red Cross, Post Office, and Ujina Hospitals. If feasible and indicated, a few days trip to Nagasaki would then be made for this type of work there.

It may be desirable at some time in the study to treat cases pre- and post-operatively with penicillin to determine the significance of infection on the healing after plastic surgery of keloid areas. This is being deferred at present for further considerations and judgment as to feasibility.

Specimens and data are to be returned to Tokyo during the first week of February for organization and further study. Histological preparation and examination of specimens is being arranged with the 406th Medical Laboratory in Tokyo.

All American persons in Japan engaged in the follow-up studies of atomic bomb survivors will be kept well acquainted with the progress of the study so that continuity will never be lost. Progress reports will also be forwarded to interested persons in the United States. It is hoped that the foundations will be laid for continued work on the problem as is necessary.

Japanese physicians who have already been studying the problem and with whom it is desired to be associated in the work include:

Tokyo:

Dr. Masao Tsuzuki
At the Tokyo Imperial University, Faculty of Medicine
Dr. Shigeru Matano
Dr. Junichi Uchida
Dr. Tetsu Watanuki

Hiroshima:
Red Cross Hospital
Dr. Ken Takenouchi
Post Office Hospital
Dr. Michihiko Hachiya
Ujina Hospital
Dr. Tomosuke Komiyama
Nagasaki:
Dr. Raisake Shirabe

IV. Supplies and requirements for the study include:

1. Solutions
   a. Zenker's
   b. Formalin
   c. 70% alcohol
   d. 10% formalin
2. Bottles, wide-mouth, specimen (200), with stoppers
3. Bottles, wide-mouth, 1000 cc.
4. Questionnaire forms printed
5. Developing and printing of photographs
6. Flash or photoflood bulbs
7. Interpreter at Tokyo, Hiroshima, Nagasaki
8. Services of a photographer for perhaps one week
9. Labels, syringes, needles, forceps, medicine droppers

Questionnaire and data forms have been prepared for use in the study. These are to be mimeographed in necessary numbers.

It should be possible to obtain the necessary supplies through supply channels available to the Commission in Tokyo.

V. Considerations of factors involved in the keloid problem of atomic bomb survivors

1. Comparison with results that would occur in healing of similar lesions of any etiology:

It is desirable that the usual reparative and healing processes that would occur under any circumstances in lesions of comparable severity as to depth and area involved due to any cause, as simple excision, for example, be understood. This involves, actually, knowledge of the fundamental factors of tissue repair, especially pertaining to the skin and subcutaneous tissues. Would granulation tissue continue to accumulate until a markedly elevated mass of granulation tissue would be present before completion of healing would occur? When does completion of healing occur? What are the factors operating to control the amount of reparative tissue which does appear? What are the fundamental contributions of leucocytes in the healing processes? Work done on factors involved in epithelialization of skin lesions should be consulted. This involved a study of healing itself, not considering other variables, as treatment, infection, etc.

2. Comparison with the outcome in healing of burns of comparable severity but of other etiology:

a. If possible, fundamental characteristics of healing of burns themselves should be understood. Are there differences associated with the healing process, depending on the physical force which caused the tissue destruction: What are the characteristics of burns produced by various wave lengths of the ultra-violet, radiant, and infra-red spectra?

b. The time-intensity factor:
What are the differences in the lesion and in the healing of similar lesions as to severity when caused by heat applied with varied intensities over varied intervals of time?

Nearly all burns of the survivors were flash burns. The members of the Commission have seen some Japanese who sustained burns from other causes during the war — flash burns from incendiary bombs, gasoline fires, and powder explosions. A few were seen who did develop keloids upon healing. Most of such cases that were seen, however, did heal with scar tissue not excessive in quantity.

3. Importance of infection in the healing of such lesions:

The influence of infection in healing of lesions as discussed in 1 and 2 above should be considered.

4. Factor of treatment:

The changes in healing resulting from various forms and degrees of treatment should be considered in the healing of such lesions as discussed in 1 and 2 above. This includes local treatment (dressings, grafting), general treatment (transfusions, nutritional care, drugs), time of application of the treatment, adequacy of treatment, ability of the person who carries out the treatment, etc.

5. The factor of the patient's general condition in healing of lesions as discussed in 1 and 2 above.

The condition of the patient throughout the healing of the lesion and the ability of the patient to provide essentials for the steps in the reparative process should be evaluated as to significance in healing of these lesions.

6. Associated factors operating in atomic bomb survivors:

a. Radiation injury:
Many of these individuals were also suffering from some manifestations of radiation injury -- decreased white blood cell counts, anemia, hemorrhagic tendency, etc. Disturbances in the steps of the reparative processes secondary to these changes are difficult to evaluate completely. It is obvious that to fully appreciate the importance of this, one must understand the part that leucocytes play in wound healing, etc.

b. The individuals concerned here were affected also by a number of the factors discussed in 3, 4, and 5 above. Many burned areas were said to have been infected. This could also have increased

the severity of the lesions as to depth of tissue necrosis and as to areas involved. Also prolonged healing with greater accumulation of infected or partially infected granulation tissue could result in part from this. The ability to combat infection must have been decreased in these individuals. Many of the survivors undoubtedly were suffering from poor nutrition, especially following the bombing.

Treatment was of necessity minimal in these cases for the most part. It was not possible to graft the burned areas as is now customary in the United States. Large areas had to heal themselves by granulating in the case of most of the survivors.

c. The burns were largely flash burns. The time-intensity data should be examined. Also the wavelengths of the spectrum concerned should be considered.

d. Factor of ionizing and neutron radiation:
It seems impossible to definitely evaluate the significance of this factor. The fact that many patients with keloids were at areas distant enough from the center of the explosion that the amount of ionizing and neutron radiation that they received must have been very low plus the fact that most of the burns were limited to exposed areas and were apparently flash burns tends to minimize the importance of the direct action by these radiations. It does seem most probable that any radiation received by survivors at the time of the bombings was "hard" in character and consisted of gamma rays and neutrons.

e. Pigmentary changes associated with the burns:
These were characteristics and have been well described in previous reports dealing with early studies of the survivors. Both depigmentation and hyperpigmentation occurred. The areas of hyperpigmentation have decreased in intensity with time and in many cases seem to have almost disappeared at the present time.

7. Existing knowledge regarding the nature and characteristics of keloids should be examined.

8. Miscellaneous

a. Question of a keloid tendency in Japanese:
Japanese physicians deny a keloid tendency in their race. However, members of the Commission have observed overgrowths of scar tissue which could be called keloids in scars of surgical incisions as well as in other healed skin lesions. However, the incidence is apparently not remarkable in scars from surgical incisions. Such wounds differ definitely from burns though in many respects (type of tissue injury, area involved, treatment, antisepsis, closure, depth). Evidence indicates that races with skins of dark color do have a higher incidence of keloids in healed scars than fair skinned races.

It is interesting that in several atomic bomb survivors elevated areas of scar tissue (keloids) were seen in donor areas where skin was removed for grafting of other areas where keloids had been excised, these keloids having developed in areas of flash burn from the atomic bomb. Keloids are said to have recurred also in individuals on

whom keloids had been simply excised and the skin edges undermined and closed.

Accumulations of scar tissues comparable in appearance to those in atomic bomb survivors have also been seen in Japanese who sustained burns from other causes -- incendiary bombs, gasoline fires, and powder explosions. However, in most of these cases the appearance of the scar tissue was not unusual in quantity.

b. That varying degrees of accumulation of granulation tissue did occur followed by a gradual change to scar of more dense connective tissue seems evident. The unusual incidence of very thick and elevated scar tissue is the striking thing. The word keloid has been used to describe such thick elevated areas of scar tissue -- this, however, necessitates definition before classification and determination of the incidence of such can be accomplished. This is a problem at present.

Apparently the burns did go through the process of granulation tissue accumulation which went on to become large in quantity in many cases, surface epithelialization finally occurring. With time, vascularity decreased gradually while the density of hyaline connective tissue increased so that the histological picture apparently was that of tissue gradually becoming more mature with fewer cells and a greater fibrous tissue composition. Contractures have occurred as usual while grossly the scar tissue has become more dense, less elevated and less red in color. Although epithelialization of the burned areas had occurred in most cases by three to four months after the injury, the scar tissue continued to increase in many so that keloid-like lesions resulted. It seems that the maximum growth of this tissue was reached eight to ten months after the bombings. Since then the amount of scar tissue has not increased as judged by gross examination.

9. The future

The natural history of the keloids does not yet seem to be completed.

Present knowledge indicates that the incidence of neoplastic changes in such lesions is increased above that for normal skin. This applies especially to burns which are slow in healing and which tend to break down at intervals. Such changes may not occur for many years, however. Locations in which chronic ulceration occurs in atomic bomb casualties should especially be observed.

APPENDIX NO. 6

THE QUESTION OF THE GENETIC EFFECTS OF THE ATOMIC BOMBING

by

James V. Neel

1st Lt., M.C., A.U.S.

THE QUESTION OF THE GENETIC EFFECTS OF THE ATOMIC BOMBING

Lt. James V. Neel

INTRODUCTION:

The ability of irradiation of various types to accelerate the normal mutation rate in a wide variety of plant and animal species is a fundamental observation in radiobiology. With the present extensive background of information on this subject, an obvious question which arises in any consideration of the late effects of the atomic bombing is the genetic one. Have the various plant and animal species involved in the bombing, including man, received sufficient irradiation to effect a detectable increase in the mutation frequency?

JAPANESE PROGRAM:

The Japanese group has appreciated the significance of this question from the first. Their activities fall into two categories, namely, investigations of human material, a function of the Medical Section of the Japanese Special Committee and for the most part at present under the immediate supervision of Dr. Ikuzo Matsubayashi, and investigations of plant and animal material, primarily a function of the Biological Section and under the immediate supervision of Dr. Yoshiro Abe and Dr. M. Chino. Conferences were held with the three above-mentioned individuals, as well as with certain other investigators, to be mentioned below. The activities of some other sections of the Japanese Special Committee also have genetic implications.

The program of the Medical Group is as follows: An attempt to determine the results of all conceptions in the Hiroshima area is being organized. All pregnant women are required by government regulation to register in the early months of pregnancy, in order that they may obtain certain additional food and clothing allowances. Government regulations also require that the termination of any pregnancy after the third month be reported. Dead births, no matter what the age of the foetus, are to be registered on a form issued by the Ministry of Welfare. Live births, no matter what the age, are registered on a form issued by the Ministry of Justice. A limited amount of information of genetic value would be provided by this system of registration if it were functioning efficiently. The Japanese Medical Group studying atomic bomb survivors at Hiroshima has attempted to supplement this information by two additional measures. The first is a questionnaire, to be filled out by pregnant women at the time of registration. This questionnaire covers briefly the medical history of the prospective parents at the time of the bombing, and the reproductive history of the prospective mother; a translation of the questionnaire is available for examination. The second measure involves an attempt, at the termination of each of these pregnancies, whether prematurely by abortion, miscarriage, etc., or at term, to obtain information on the nature of the foetus or child. It is well known that abnormal foeti tend to be eliminated prior to term, thus necessitating

a careful check on abortion and miscarriages. This program has not yet gone into operation at Hiroshima, so that no data are available. As yet no similar program has been planned for Nagasaki.

The Japanese program proceeds along obvious lines and so far as it goes is soundly conceived. There are apparent, however, two serious defects. The first of these is the lack of suitable control studies. It is obvious that in this case the approach to the problem of genetic effects is the statistical one. A specific pathology in the next generation can never be attributed to the effects of the bomb, but if there is a definite increase in the occurrence of abnormal products of conception in irradiated persons, one may surmise that this is related to the bombing. One must therefore have control studies comparable in extent to those on irradiated persons. The Japanese had planned to use the vital statistics of the past some years as a partial control. This leads to a consideration of the second defect in the present scheme. It is the opinion of the Commission that there are serious inaccuracies in the present vital statistics returns in Japan. It is obvious from a study of the present statistics that only a portion of abortions and miscarriages is being reported. It also seems probable that the occurrence of certain congenital malformations in the new-born may be concealed by the practice of infanticide. Further, in the absence of premarital and neonatal serological tests for lues, the incidence and importance of this disease in the new born, and its role in the production of stillbirths, is poorly known.

CONTROL AREAS:

These defects in the Japanese program are at least in part remedial. The necessity of adequate control studies was appreciated by the Commission from the first, and from data available in Tokyo three areas were picked as possible control sites before the group departed on the survey tour. During the tour each of these sites was scrutinized as to similarities to Hiroshima and Nagasaki, and investigated regarding facilities for any studies that might be undertaken. These three areas were the cities of Osaka, Fukuoka, and Kure. After due consideration the latter was chosen as most suitable. It is comparable in size to Hiroshima, being located about 25 miles from the former. The city was heavily bombed during the war. From statistics furnished by Col. Howe of the Public Health and Welfare Section of SCAP, it would appear that the nutritional levels of Kure and Hiroshima are comparable, both being relatively poor. There is a Military Government Team in Kure, but none in Hiroshima. The proximity of the cities makes commuting between the two feasible, thus simplifying the necessary field of organization. Living quarters are available at Kure. Hospital facilities can be obtained in Kure at the Kure Mutual Relief Hospital, and tentative arrangements for such facilities have been made. A meeting has been held with the leading physicians and midwives of the city, and the possibility of using Kure for control studies on Hiroshima and Nagasaki presented. The initial steps have thus been taken to set up an adequate control area.

RELIABILITY:

The problem of improving the reliability of the vital statistics is more serious. It can be met in these areas to a certain extent by enlisting the aid of physicians, midwives, and the general public through eduction and directives. In this connection it should be pointed out that

85% of deliveries in Japan are by midwives. These steps, however, are not enough. Additional Japanese personnel must be obtained for these areas. This problem, of improving the quality of the vital statistics, is of importance to all Japan, a fact realized by SCAP shortly after the beginning of the occupation. At present a large-scale reorganization of the collection and tabulation of vital statistics in Japan is under way, under the general direction of Mr. L. V. Phelps in the Public Health and Welfare Section of SCAP. Numerous conferences have been held with him as to the most fruitful avenues of cooperation. A memorandum to Mr. Phelps on this subject is included in the appendix.

SPECIAL CONSIDERATION:

Certain genetical and practical considerations vital to the formulation of any program should be introduced at this point. It is convenient to distinguish between dominant and recessive genes, dominants finding phenotypic expression in the heterozygous state but recessives requiring the homozygous condition for their manifestation. Mutation resulting in dominant genes may be detected in the next generation, whereas mutation resulting in recessives may go undetected for many generations, unless the recessives happen to be sex-linked. Inasmuch as the majority of naturally occurring and irradiation-induced mutation in experimental material have proven to be recessives, it follows that only a fraction of any genetic change that may have been induced could be detected by the above-described methods. A program to detect the recessive mutations that may come to light two, four, or more generations hence appears impractical. What we are dealing with is not a laboratory experiment, but a situation which must be approached with due appreciation of the present conditions in Japan. Under the circumstances it is impossible to look beyond the next ten or twenty years, a fact which suggests that attention be concentrated on dominant and certain sex-linked recessive mutations. Furthermore, in view of the possibility of genial elimination of mutations associated with chromosomal aberrations, the program should be organized as rapidly as possible. On the other hand, the organization should be such that observations may be extended to the second, third, or later generations if that becomes feasible.

The survivors of the bombing will have received doses of irradiation ranging from negligible to just short of lethal. It is obviously impossible to say on a priori grounds whether a sufficient number of people will have absorbed sufficient irradiation to produce sufficient dominant mutation to result in a significant alteration of vital statistics. However, comparison of this situation with the known experimental facts suggests that the magnitude of the change, if detectable at all, will be small. Large scale studies utilizing all the available material and accurate vital statistics are thus necessary. Anything short of such an investigation can only yield equivocal results - although there is no guarantee that large scale work will not also yield equivocal findings. It is important to point out that there is a definite limit to the amount of clinical material available. For instance, it can be estimated that the number of survivors within the 2-km zone, where radiation sickness was common, is approximately 80,000 in Hiroshima, and 15,000 in Nagasaki. Many of these have since left the area. Let us assume that we confine our studies to these cities, without trying to locate those who left subsequent to the bombing, and that there are now

present in these cities some 50,000 of the survivors within the 2-km. ring. A mean birth rate of 25 per 1000 per year for the next 10 years provides a sample of only 12,500 births from "heavily irradiated" persons. However, it would be necessary to screen many persons to derive this sample. There is room for debate as to whether the effort which must be expended on such studies is justified by the possible scientific returns. However, in our interest in this as an experiment in radiobiology we should not lose sight of the public health aspects of this situation in an age of atomic energy. The latter may by themselves justify a considerable expenditure of effort, and failure to demonstrate a genetic effect of the bombing is fully as important as finding a measurable influence. In this connection it should also be pointed out that regardless of whether these studies reveal a genetic effect of the atomic bombing they will, if properly organized, yield much fundamental information on the genetic structure of the Japanese people.

PROPOSED PROGRAM:

In the light of the foregoing, it is felt that a program to detect possible genetic effects, if deemed desirable, can best proceed along the following lines:

1. Organize, in Hiroshima, Nagasaki, and a control area (Kure), a system of pregnancy registration that works, this to include the irradiation history of the parents.

2. Obtain as complete information as possible on the outcome of each registered pregnancy.

3. Follow up each report of an abnormal termination of pregnancy or a congenital malformation with detailed family studies.

4. Develop a system of checking on the completeness and accuracy of the records, such as requiring registration by both family and physician or midwife.

5. Conduct these studies on a sufficiently large scale that the results will have statistical significance.

6. Integrate this program with an improved and more accurate system of death certification, so that genetic effects not apparent at birth but detected subsequently may be recorded.

7. Put the program insofar as possible into competent Japanese hands, through the Japanese Government, with only enough American supervision and cooperation to facilitate a smoothly functioning program. This program at best will detect only a fraction of dominant mutations.

PARTICULAR CONSIDERATIONS:

Attention must be given to the problem of following persons who were in Hiroshima and Nagasaki at the time of the bombing and subsequently departed.

A question related to the problem of genetic effects is that of diminished fertility or sterility as a result of irradiation. It is suggested that the reproductive histories of several hundred women in the child bearing age who suffered from radiation sickness be compiled during the next ten years, for comparison with the reproductive histories of a comparable number of women who were in Hiroshima or Nagasaki at the time of the bombing but did not show the symptoms of radiation disease.

The assay of possible genetic effects is much more readily performed in plant and animal material than in man, with, however, the important qualification that in animal and, to a lesser extent, plant material, it is often impossible to be certain of position at the time of the bombing. The Japanese efforts to utilize animal material have been completely nullified by the chaotic conditions and poor food situation. Thus, in Hiroshima Dr. Yoshiro Abe of the University of Literature and Sciences had in the animal colony of the University at the time of the bombing 32 rabbits. The approximate distance of the colony from the hypocenter was 1.6 km. Eighteen died as a result of the bombing. It was planned to use the remaining 14 in breeding experiments. However, because of poor caging facilities and predators, some possibly human, half of the remainder were soon lost, and it was then necessary to sacrifice the few that were left because of food shortages. Dr. M. Chino and Dr. T. Komai of Kyoto Imperial University, both with an extensive experience in Drosophila genetics, undertook to collect Drosophila in the Hiroshima area and analyze their genetic composition, for comparison with other wild populations of flies. These experiments were soon abandoned because of lack of facilities, especially fly media, and lack of adequate testor stocks.

The work on plant material, insofar as we have been able to familiarize ourselves with it, has been hardly more profitable. Dr. Naomasi Shimotomai, of the University of Literature and Sciences of Hiroshima, and Dr. Hiromi Nakayama, of Tokyo Imperial University, have both studied the occurrence of variegation in plant leaves in the bombed areas, this variegation consisting of albino areas on otherwise green leaves. Variegation has been observed in a variety of plant species, and photographs illustrating this point are available for the Commission. However, there are no control observations as to the normal frequency of such variegation, and thus far no attempt to analyze the nature of the phenomenon. The complicated problems presented by variegation in plants are well recognized. It is not known in the present instance whether this variegation reflects a change in the plastids or in the nucleus of an early leaf bud. If it is due to a nuclear change, certain rather diverse possibilities have to be recognized, each of which requires some interesting assumptions. Albinism is almost invariably a recessive trait. In explanation of these spots one must therefore assume that two homologous loci were simultaneously affected, or that the plant was originally a heterozygote, and the normal locus affected, or that this is the very rare dominant albinism.

ANIMAL EXPERIMENTS:

If it seems desirable to initiate certain animal experiments, to parallel the work on man, then of the various plant and animal species that could be employed, the fruit fly, Drosophila, is most susceptible to

an exact genetic analysis. The disadvantage to work utilizing this organism is that in the ten or more fly generations which have elapsed since the bombing, there has undoubtedly been a great deal of migration, as well as elimination of dominant and, to a much lesser extent, recessive mutations by natural selection. If the genetic variability of flies collected in the bombed areas was found to be significantly greater than in several control areas, this could be construed as evidence for irradiation-induced changes in the genetic composition of these - and presumably other - organisms. However, a negative result would not mean that no such change would have occurred, since selection and migration might by now have rendered the effects of this insult to the germ plasm undetectable. The value of a Drosophila program is debatable.

If a Drosophila program is undertaken, it is suggested that it utilize flies collected at Nagasaki, the reason being that the total dose of irradiation received by organisms in this area was quite possibly greater than at comparable distances from the hypocenter in Hiroshima, and that the dose was distributed over a longer period of time.

OBSERVATION ON PLANT MATERIAL:

The Japanese have made a number of observations purporting to show that vegetables grown in Nagasaki from seed from plants that were well beyond the known radius of bomb effects tended to assume unusual forms when grown near the hypocenter. The most extensive of these observations to come to our attention were those by Dr. Takeo Furuno, formerly chief of the Agriculture Station of Nagasaki Prefecture, and at present director of a society for the better utilization of land by crops. He has maintained two experimental garden plots, one 150 meters from the hypocenter, and the other 500 meters from the hypocenter. Abnormal vegetative forms of Brassica chinensis, Lappa edulis, Cucurbita moschata, Solanum melongena, and other species are reported to be far more frequent in the plot nearest the hypocenter. A detailed report of these findings is on file. This is attributed to some effect of the atomic bombing on the soil. These two plots were inspected and specimens of the vegetables examined - it was the opinion that soil differences complicate the picture to an extent where it is impossible to reach conclusions.

DIFFICULTIES:

The difficulties of organizing along sound lines any genetic program, whether concerned with man, Drosophila, or plant material, are great. Unless through various channels a major effort can be organized, involving at a first estimate 15-25 Japanese personnel of various types, the results will be unsatisfactory and the effort largely wasted. The success of the effort is closely linked with the problem of improving Japanese vital statistics, and this in turn is closely related to the problem of improving the general level of medical practice in a country under severe post-war stress. These are problems whose roots go deep. If, on the other hand, such a large scale project can be set up, the scientific value almost inevitably will extend beyond the specific question of a genetic effect of the atomic bombing.

APPENDIX NO. 7

MEMORANDUM TO: L. V. PHELPS

RE: VITAL STATISTICS

APPENDIX 7

GENERAL HEADQUARTERS
SUPREME COMMANDER FOR THE ALLIED POWERS
Public Health and Welfare Section

28 December 1946

MEMORANDUM

To: Mr. L. V. Phelps

From: Atomic Bomb Casualty Commission (ABCC)

Re: The Relation between Vital Statistics and the Work of the ABCC

1. The ABCC has for the past several months been engaged in formulating a long-range program of comprehensive studies on persons in Hiroshima and Nagasaki exposed to the various effects of the atomic bomb. Two important problems included in the projected studies are:

a. The question of whether there have been any detectable genetic effects of the atomic bombing, and

b. The question of whether the length of life and the incidence of various diseases in the population has been altered.

2. In order to answer the first of these questions, one must have accurate information on the incidence of abortions, miscarriages, premature deliveries, and stillbirths, the live birth rate, and the incidence of various congenital malformations. These data must be available not only for Hiroshima and Nagasaki, but for a suitable control area or areas.

3. In order to answer the second question, one must have accurate contagious disease records, and registration of deaths not only by primary but also by contributing causes. Autopsy records on a large scale are highly desirable.

4. It is obvious that accurate vital statistics are basic to the study of these problems.

5. During the period 4 December 1946 to 20 December 1946, the Commission was engaged in a survey tour of Japan. After a study of several areas, the city of Kure was selected as being a suitable control area for the contemplated studies in Hiroshima and, to a lesser extent, Nagasaki. Kure and Hiroshima are similar in location, size, damage due to bombing, and nutritional level. During the course of this survey, Japanese groups in a position to contribute to accurate vital statistics were contacted in these three areas, as follows:

a. In Nagasaki - On 11 December 1946, a conference was held with Dr. M. Yamagishi, Chief of the Public Health Service of Nagasaki Prefecture, at which the reasons for our particular interest in the vital statistics of Nagasaki were stated, and in which the recent vital statistics of the city were discussed. It was apparent to all present, from the ratio of abortions

to livebirths, that only a fraction of the abortions in the population was being reported. On 13 December 1946, a further conference was held, with Dr. Yamagishi again present, and in addition, Dr. Toru Shimomura, President of the Nagasaki Association of Obstetricians and Midwives, and Dr. Tamotu Sano, Professor of Pediatrics at the Nagasaki Medical School. The problem was again presented and the necessity for accurate information stressed. The system of registration under way at Hiroshima was described. The new vital statistics forms were also discussed. Much interest was expressed by the Japanese present, but it was clearly indicated that additional personnel and training would be required if more adequate statistics were to be obtained.

b. In Hiroshima - On 19 December 1946, a conference was held with Dr. Ikuzo Matsubyashi, Chief of the Public Health Service of Hiroshima, Dr. Yekizo Watanabe (Gyn.), Dr. Soichi Matsumoto (Gyn.), Dr. Shuzo Ishibashi (Obs. and Gyn.), Dr. Kaei Sawasaki (Gyn.), and Mrs. Setsu Yamamoto, President of the local midwives society, and 11 other leading midwives. The general problem of the effects of the atomic bombing on vital statistics was presented, after which Dr. Matsubyashi presented and described a new form to be used in following up all births in the Hiroshima area, this form emphasizing history of parents at the time of the bombing, and the occurrence of malformations in children. There was some discussion as to the best way to obtain accurate information on possible malformed children, and it was suggested by the physicians present that the city be divided into districts, with a physician responsible for following up in each district any malformations recorded by midwives.

c. In Kure - On 20 December 1946, a conference was held with the leading physicians and midwives of the city, at which time the general problem of atomic bomb effects in Hiroshima and Nagasaki was presented, and the necessity of having a control area given. It was stated that Kure had been chosen for control studies. The necessity for accurate vital statistics in this area was then emphasized.

d. As a result of conversation with these and other groups, the Commission believes that by no means all abortions, stillbirths, miscarriages, premature deliveries and stillbirths are being reported and that the occurrence of certain congenital malformations may be concealed by the practice of infanticide.

6. The Commission is in the course of making arrangements for small office-laboratory-clinical units in the Red Cross Hospital of Hiroshima and the Mutual Relief Hospital of Kure. Here members of the group will work in close contact with Japanese physicians in the area.

7. It is understood that the Division of Vital Statistics, P H and W, GHQ, SCAP, through the medium of the Japanese Government, is launching a campaign designed to improve the quality of Japanese vital statistics.

8. It is the feeling of the Commission that close cooperation with the Division of Vital Statistics in this undertaking is highly desirable and because of the above described organization of the Commission's work, practical. The following suggestions are raised for consideration as ways in which this cooperation may be expressed in concrete actions:

a. It is suggested that a representative of the ABCC accompany Mr. Phelps, in charge of vital statistics for SCAP, on his proposed mid-January tour of Kure, Hiroshima, and Nagasaki, in order that the ABCC may further familiarize itself with the program to be carried out by the Division of Vital Statistics.

b. It is suggested that the appropriate Japanese Ministry be requested to devote some special effort to the attempt to obtain accurate statistics for Kure, Hiroshima, and Nagasaki, because of the great medical interest attached to these areas. Moreover, the Kure area, intensively studied, might serve as a yardstick for comparison with other similar locations in Japan.

c. It is suggested that in the three areas under consideration, some cross check on the reliability of the reports be instituted, such as requiring registration by both physician and family.

d. It is suggested that in the Kure-Hiroshima areas the Commission be active in the organization of teams of Japanese or Japanese and American physicians, to follow up any cases of congenital malformations reported by obstetricians and midwives.

e. It is suggested that the problem of securing more accurate records of causes of deaths in these areas be reviewed that the aid of the above-mentioned teams of physicians be used in this matter, and that means of obtaining more extensive autopsy records be sought by the Commission.

f. It is suggested that the problem of establishing a system of bookkeeping to keep track of survivors of the bombing who have moved elsewhere be considered.

APPENDIX NO. 8

MEMORANDUM TO: COL. HARRY JOHNSON

RE: INTERIM PROGRAM

APPENDIX 8

GENERAL HEADQUARTERS
SUPREME COMMANDER FOR THE ALLIED POWERS
Public Health and Welfare Section

APO 500
27 December 1946

MEMORANDUM

To: Colonel Harry Johnson, Chief, Medical Service Division, PH & W

From: Dr. A. M. Brues and Dr. P. S. Henshaw, Atomic Bomb Casualty Commission, PH & W

Re: Interim Program, Atomic Bomb Casualty Commission

1. In accord with its original objectives, the Atomic Bomb Casualty Commission has taken the following steps:

a. Contacted the various Japanese investigators who have been making studies of atomic bomb casualties.

b. Visited Hiroshima and Nagasaki and surveyed the needs for setting up a long-term study of atomic bomb casualties.

c. Selected an appropriate control location (Kure) for study similar to that planned for Hiroshima.

2. In order to maintain a continuity between the present visits and the long-term program which it is expected will be initiated soon, Lts. Melvin A. Block and James V. Neel will remain in the area for the time being: Lt. Block for the remainder of his 90-day TDY and Lt. Neel for a longer period, requiring new orders by 23 February.

3. Lt. Block has been asked to facilitate the work on keloid studies as follows: to work in close collaboration with the Japanese group, which is making surgical follow-up studies (Dr. M. Tsuzuki and associates); to arrange for histopathologic preparations on 75 to 100 biopsy specimens at the 406th Medical Laboratory; to obtain slides and medical records in appropriate numbers; to obtain such photographs as are possible to illustrate the cases; to supply fixatives, drugs, and glassware where necessary to carry out keloid studies; to aid in statistical studies of keloid incidence; and to make such physical examinations as he can, consistent with the Japanese handling of the patients.

4. Lt. Neel is being asked to organize a long-term study relating to possible genetic effects of the atomic bombing, collaborating with the Japanese and SCAP groups dealing with vital statistics. Lt. Neel is also being asked to assist where he can in a general way in all phases of the study, and to serve as our central contact man during the "interim" period.

5. Lt. Ullrich (USNR), having completed his assignment, is to return to the United States in a week or so. This step is being taken after consultation with Capt. Shields Warren (USNR), Boston.

6. An attempt is being made, through Capt. Warren, to have Lt. Snell (USNR) transferred to this work.

7. As explained earlier, tentative arrangements have been made for office and laboratory space at the Red Cross Hospital in Hiroshima and at the Mutual Relief Hospital in Kure. Directives from your office will be needed to make these arrangements official.

8. Adequate coverage will be needed from your office to make it possible for Lts. Block and Neel to work in accord with military protocol, and, at the same time, on a high professional level. This will include billeting, messing and PX facilities, transportation (two jeeps and a sedan), off limits passes, and certain office help (2 stenographers, 2 interpreters and 2 laboratory assistants).

9. Letters from your office will be needed as follows:

a. To Col. R. C. Snyder, C.O. of Chugoku Region Military Government Team, Kure, to cover the items mentioned in paragraph 8 above;

b. To Col. Delnore, Nagasaki Military Government Team, saying that representatives of the Commission will need to visit Nagasaki during the interim period and that additional arrangement will need to be made later;

c. To the Japanese Red Cross Society, requesting the temporary use of two rooms on the second floor of the Red Cross Hospital in Hiroshima, as tentatively arranged;

d. To the Mutual Relief Society of Japan, requesting the temporary use of two rooms in the Kure Mutual Relief Hospital, as tentatively arranged; and

e. To the Japanese National Research Council, requesting that the working relationship between the ABCC and the Japanese groups studying atomic bomb casualties be continued on the same high plane as has been the case during the past few weeks, and that Dr. Masao Tsuzuki, in particular, be asked to continue his work with both the Japanese and the American groups.

10. It is requested that all persons or groups that may come to your office, interested in human atomic bomb damage, be referred at once to the ABCC. This is necessary because the present Commission has been formed at the request of most of the interested groups, in order to accomplish coordination.

11. Finally, Drs. Brues and Henshaw will return to Washington at least by the middle of January and will lay before the groups they represent (the National Research Council, American Cancer Society, Army, Navy, Manhattan District, Atomic Energy Commission, and Public Health Service) the situation in Japan pertaining to long-term casualty studies as they see it. It is expected that a formal organization with a director and budget will be established at once. In any case, information from Washington will come to you concerning further steps.

APPENDIX NO. 9

REPORT ON THE MEDICAL STUDIES

OF THE EFFECTS OF THE ATOMIC BOMB

by

DR. MASAO TSUZUKI

Professor of the Tokyo Imperial University

From the Medical Section (Chairman: Dr. Masao Tsuzuki), the Special Committee for the Investigation of the Effects of the Atomic Bomb, the National Research Council in Japan.

N.B. - This report is a summarized one of the Medical Section, based on the various reports which have been presented by the medical investigators in Japan by February 28, 1946. Scientific reports of each survey team and investigator, dealing with special features, will be presented separately.

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2) Mechanical Energy and its Injurious Effects.

3) Radioactive Energy and its Injurious Effects.

4) The Atomic Bomb Injury.

Chapter II. Clinical Course of the Atomic Bomb Injuries.

1) The First Period (the Early Stage).

2) The Second Period (the Middle Stage).

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Addendum: List of the Reports on the Medical Studies, Presented by February 28, 1946.

CHAPTER I

Injurious Effects of the Explosion of the Atomic Bomb upon the Human Body.

An explosion of an atomic bomb produces various kinds of destructive forces simultaneously and abundantly. These powers injure the human body directly and indirectly. A damaged condition of the human body caused by the explosion of the atomic bomb will be called summarily an "Atomic Bomb Injury".

From the medical point of view, observing the mechanism of the etiology of the atomic bomb injuries, we would like to classify the injurious powers into the following kinds, but we must not forget that these powers will not act separately; they will act always in a combined form.

(1) thermal energy

(2) mechanical energy

(3) radioactive energy

In this chapter, there will be discussed violent energies of these forces and their injurious actions separately; then we will describe in the next chapter the whole course of the atomic bomb injuries which occur by combined effects of the various forces.

1) Thermal Energy and its Injurious Effects.

Enormous amounts of violent light and heat waves (containing a great amount of ultra violet rays), which were produced at the instant of the explosion, caused burn wounds on very many persons within a radius of 4 km from the ground center. The burns were seen mainly on exposed parts of the body. These burn injuries were caused by instantaneous action of thermal (light and heat) energy. The burns outside a 2 km radius were comparatively superficial and slight.

In the circle within a radius of 2 km, there were many burn casualties of a severe type; especially in the central area, within a radius of 1 km, the burn action was so violent and severe that the entire thickness of the skin was burned and moreover the internal tissues and organs were also damaged by heat energy. Consequently many patients suffered from severe burns and lost their lives immediately or within a few days.

These burn injuries we shall call in short, "Atomic Bomb Burn". The burns which are caused by the primary heat waves shall be called "Primary Burn" or "Flash Burn". Many persons within a radius of 3 km from the ground center had their skin secondarily burned from the burning or superheating of their clothing. These burns we shall call "Secondary Burn" -- by burning cloth, "Scorch Burn"; by superheated cloth "Contact Burn". The burns which were caused by burning of the houses shall be called "Flame Burn". We can assume that many patients with flame burns were burned to death by the secondary fires.

Many of the atomic bomb burn patients outside the 3 km radius were camparatively mild cases. They showed simple erythemas or formation of small vesicles, like a case of severe sunburn. They were cured in 1-2 weeks. In the circle within a radius of 3 km the burn injuries were pathologically all of the 3rd degree, i.e., there occurred escharotic changes of the tissues, the depth of injury was different in each case. These flash burns appear quite specific, since they were caused by heat of tremendous intensity and of very short duration (shorter than 1/10 sec). Accordingly such flash burns look just like a specific burn caused by superthermal energy.

The pathology of burn injuries caused by superthermal energy was studied during the war, thereby giving medical profession real experience. Burning by an incendiary bomb was one such a specific example for it was caused by a superthermal flame (over 3,000 C). If such superthermal energy acts upon the human body for an instant, i.e. shorter than few tenths of a second, there will occur a superficial lesion of the skin, where a thin layer of burning crust will be observed. The crust will scale off spontaneously after a few days or a week and there will remain a shiny area of skin with a red-brown colour. The burning crust consists of burned debris of the outer layer of the epithelium and congregation of miliary vesicles in the epithelium. The whole appearance of this burned crust is just like that of herpes. A covered part of the body, even if covered by thin material such as a cap or shirt, is not affected. Therefore, the line between burned and unburned parts is clearly visible. If the superthermal energy would act a little strongly, in other words, for a little longer time or with a little greater intensity, the severity of the injury should become astonishingly greater. In the severest cases, the total thickness of the skin is burned and moreover the internal tissues are also damaged, as if they were roasted and death occurs immediately. Also in such a case, the superthermal energy will blow down with a blast, so it will act as a "blast heat". It will blow off the scorched clothes and the burned skin, too. Between these two extreme conditions, there are, of course, many intermediate cases. Proportional to the intensity of the heat and its duration, the depth of the internal damages increases and the general disturbance due to the internal damage becomes more marked.

If a burn of the skin extends over a certain area, there will be observed a degeneration of the internal organs, especially the liver and kidney. In the severest cases of burn, even if the burned area is limited, such general disturbances have been observed distinctly. It has become clear now that the general disturbances in severe burn cases will not occur only as a complication of damage to the skin, but also direct damage to the internal organs.

In cases of atomic bomb burn, it was recognized that similar circumstances, just as in the severe burns by the superthermal energy, also occurred in the central district. That is a primary direct damage by superthermal energy. In atomic bomb burns, the internal organs would be, moreover, affected simultaneously by radioactive energy, so the degree of the primary direct damage would become rather more marked. Atomic bomb burns however occurring at a distance over 3 km from the ground center, can be treated primarily as a simple superficial burn of the skin, because at this distance, the heat intensity was less and the radioactive

energy was also diminished.

2) Mechanical Energy and its Injurious Effects.

At Hiroshima, all wooden houses were totally destroyed and totally burned in the area within a radius of 2 km from the ground center. Strong concrete buildings were not completely destroyed, but their windows were blown out and the inside of the buildings were totally burned. It was thought by many authorities right after the disaster that the houses were destroyed by secondary fires. It is therefore possible that a primary fire could occur in the circle within a radius of 1,800 m from the ground center. At Hiroshima, the wooden houses between a radius 2 - 4 km from the ground center, were destroyed totally or partly, according to their distance, but fires did not break out. The breaking of window glass was noted even as far as over 16 km, effects on trees over 20 km. The feeling of a blast was recorded over a distance of 60 km.

The mechanical characters of the blast pressure, brought forth by the explosion of the atomic bomb, were surveyed from various points of view by the Scientific as well as Engineering Sections of the Special Committee. Many special conditions of blast pressures and their effects have already been discovered, but the direct effects of blast upon the human body have not yet been so clear. It was alleged some persons were blown for several meters by the blast action. Some were suffering from damage to their internal organs. The blast injuries which we observe usually at the explosion of ordinary bombs or shells - i.e., no visible wounds on the surface of the body and some injuries or hemorrhages of the internal organs (brain, lung, liver etc.) - were not found on the records of the patients of the rescue organizations or in the personal experience of the physicians. On the other hand, in the central district, there were many patients severely burned, with the burned, torn skin flaps hanging loose. On account of these facts, we would like to suppose that the blast effects of the atomic bomb would be a little different than those of the ordinary one. But we have not been able to grasp the real aspects of the effects of the blast action of the atomic bomb, in the data, which we have studied.

There occurred many cases of various kinds of mechanical injuries, e.g. crush deaths, severe injuries of internal organs or bones by falling houses. Many mechanical wounds were caused by destruction and scattering of houses and furniture. Wounds by broken glass were too many to be counted even at places far distant from the ground center.

It was suspected that the majority of the severely wounded persons under the falling devastated houses would be burned to death by the subsequent fires. It could be presumed by the following facts: among the wounded persons who were admitted into the rescue organizations directly after the accident, the great majority of cases (over 90%) were burn patients, cases of mechanical wounds, such as fractures of bone, were very few. Those mechanically wounded had escaped mostly by their own efforts from the ruined houses. In the clinical course of these mechanical wounds, no differentiation has been proved, compared with an ordinary bomb wound. Few fracture cases were examined, but no abnormality in their healing process was noted. These cases showed no peculiarity by x-ray examination. Some slight wounds or lacerations become often worse sometimes had a tendency toward gangrenous changes, when these patients showed manifest

symptoms of radiation sickness. It may be based upon the alternation of tissue reaction against injury or infection, due to the damage of functions of internal organs, caused by radioactive energies. These relations will be discussed again later in the following paragraphs.

3) Radioactive Energy and its Injurious Effects

Various radioactive energies are emitted by an explosion of an atomic bomb. Roentgen rays, gamma-rays and neutrons are 3 important energies which can cause significant effects upon the human body.

Within a radius of 1 km, there reached tremendous amounts of radioactive forces. Persons who were outdoors at that occasion were affected by all kinds of these forces. Persons in well-covered places in concrete buildings or in a strong underground trench, were less affected. The active injurious range of radioactive energies seemed to reach about 4 km. Outdoors the effect was much more severe than that indoors.

What happened to a human body by such a strong radioactive energy? First of all, damage to blood, then to hematopoetic organs - bone marrow, spleen and lymph nodes. All are destroyed or damaged severely. Lymphocytes are most sensitive and are destroyed first. Then other internal organs, such as the lungs, intestines, liver, kidney etc. are affected and their functions are disturbed subsequently. If these damages happen to be severe, then organisms die mostly within a few days, some of them die in 2 weeks. When a moderate degree of damage is caused, the majority of cases complain of severe symptoms in 2 - 6 weeks and many of the sufferers die. Slight damage would cause no death, but some disturbances might occur during several months.

Our survey has revealed that severe damage was seen within a radius of 1 km, moderate damage in the area 1 - 2 km, slight damage in the area 2 - 4 km.

The patients who were affected severely, died mostly in a few days. Affected outdoors, they suffered also from severe burns simultaneously, some of them had moreover a blast effect in addition. Typical symptoms of these severe effects were high fever, extreme general malaise and exhaustion, vomiting, hematemesis, hemoptysis, hematorrhoea, hematuria, etc. These symptoms arise from severe damage to blood and internal organs of the whole body. The bleeding symptoms in an early stage are said to be based on the damage of the alveoli of the lungs, mucous membranes of the stomach and intestines, and tubules of the kidney. Few patients complained of unconsciousness or excitation, but most of them were lucid until their death, which occurred accompanied by general weakness. Some persons escaped from crush death or severe injury, even though they were in a building at a distance within 500 m from the ground center. These persons were damaged relatively severely by the radioactive energies. They complained in several days of severe bleeding symptoms - hematemesis or hematorrhea and often gingival bleeding, mucous and bloody diarrhoea. Many of those patients died of these bleeding symptoms in the course of several days. Those patients showed a continuous fever - 38°C - 40°C. It was said therefore at that time that an epidemic disease like a dysentery might have broken out. Some official procedures for prevention of infectious diseases were suggested. It was also a fact that at that time

some real cases of dysentery and typhoid fever did occur. These circumstances produced consequently much confusion, when we were working afterwards to make clearer the real aspect of the atomic bomb injuries.

Among the persons who were in wooden houses (mostly upstairs) or in shadow outdoors in the area 500 - 1,000 m from the ground center and had no severe mechanical wounds or severe burns, there were many, after about 2 weeks, who complained of epilation, fever, and then hemorrhagic and necrotic gingivitis or tonsillitis. They had successively reddish-violet hemorrhagic spots on the skin of their faces, trunks and extremities. Some of them had mucous or hemorrhagic diarrhoea. The diarrhoeal feces were characteristic in containing no pus. Some complained of epistaxis.

The patients, having these hemorrhagic symptoms afterwards, used to vomit mostly on the day of the explosion or after a few days. 1 - 2 weeks before the outbreak of the symptoms they usually lost their appetite. At the onset of the symptoms they had a high continuous fever of about 39°C and sometimes superthermal fever of 40°C. A few patients complained of chill or rigor, but many of them did not.

The clinical courses of these patients were similar. The majority of the patients died with a continuous high fever in about one week. If the fever curve shows a tendency toward descending by crisis or lysis after about one week, the prognosis becomes favorable and all clinical symptoms change for the better.

The persons who were within a radius of 1 - 2 km from the ground center suffered from moderate effects of radioactive energy. Especially the persons outdoors had comparatively severe damage with burns, but the persons who were in houses or in shadows and suffered from no severe mechanical nor burn wounds, had of course comparatively less damage by radioactive energy. About half of those patients complained of symptoms of epilation, fever and hemorrhage after 3 - 6 weeks. Some showed severe symptoms and died. Almost all of those patients who vomited directly after the bombing had a loss or diminution of appetite. Such digestive symptoms usually passed in a few days and the patients were feeling better for varying intervals and then the symptoms of epilation, hemorrhage etc. broke out. The inciting factors, by which these patients developed such severe symptoms, were overwork, cold and digestive disturbance etc.

As soon as the symptoms of epilation and bleeding had broken out, the slight, almost cured, lacerated or burned wounds changed their appearances suddenly, becoming worse and showed a necrotic tendency. The condition of those wounds could not be easily cured by ordinary methods of wound treatment. The patients whose wounds became worse proved mostly to have a poor prognosis. The majority of these cases died.

The patients who had a severe or moderate damage by radioactive energy showed remarkable changes of their blood pictures. Hemoglobin content diminished to 50%, the number of erythrocytes decreased to 2 - 3 millions in one cubic millimeter. Sedimentation of the red blood corpuscles was counted over 50 mm in one hour, sometimes over 100 mm in one hour. The most remarkable change of the blood picture was a decrease of the number of the white blood corpuscles. In the severe cases, the number was usually under 1,000 in one cubic mm, often under 500. In the moderate cases, it was usually

under 2,000.

The mechanism of the decreasing of the number of the white blood corpuscles seems to proceed in the following bi-phasic way. At first the lymphocytes decreased remarkably, directly after the bombing. In some severe cases it was found that almost all lymphocytes disappeared within several days. Then, in 1 - 2 weeks, it was noticed that the granulocytes were decreasing markedly. It seemed to coincide with the period in which the fever or the bleeding symptoms appeared. When the decrease of the number of the granulocytes became manifest, that was in 2 - 4 weeks, the number of lymphocytes had already increased a little. Consequently a decrease of granulocytes and a relative increase of lymphocytes was observed at this period. So we have therefore "Agranulocytosis".

The number of platelets did not decrease so much in the early stage. After 2 weeks it decreased markedly, in some severe cases under 10,000.

The picture of the bone marrow of the severe cases was one of extreme devastation, the number of nucleocytes was 1,000 - 4,000. The number of myelogenous and erythroblast types were decreased greatly. On the contrary, reticulocytes and plasmacytes were increased. Lymphocytes were relatively in a high percentage.

When the clinical symptoms became better with a lessening of fever, the blood picture improved also. A real recovery of the blood picture to a normal condition will occur after a certain time (about one month). In the recovery of the blood picture, there is a difference between the relationships of various elements. Comparing the recovery of leucocytes with that of erythrocytes, the former recovered more quickly than the latter. Therefore, there remains for some while an anemic condition to a certain degree.

The persons who were in the area within a radius of 2 - 4 km from the ground center suffered from mechanical or burned wounds of moderate or slight grade respectively. They had moreover some damage by the radioactive energy too. Most of these persons did not show any symptoms of radioactive damage, but in many of them it was proved that the number of their leucocytes decreased somewhat, to about 3,000 - 4,000. Few of them complained of epilation or bleeding symptoms (gingival bleeding, skin spots etc); they recovered rapidly of course, because they were affected only slightly.

The following observations were reported: the persons who had slight flash burns on the small area of their face, neck, shoulder, hand or foot etc., complained rarely of above mentioned disturbances by radioactive damage. Occasionally, even though they did show such symptoms, these were always mild. It is conceivable that the degree of the damage would be less, because almost all of these persons were affected at a distance over 2 km from the ground center. On the other hand, there are the following, rather hypothetical opinions. Those patients were obliged to keep themselves quiet on their beds, due to their mechanical or burned wounds. Superficial burn wounds would stimulate the affected hematopoetic organs and promote the regeneration of blood elements. Consequently outbreaks of the symptoms of the radioactive damage might be slighter.

The above mentioned damaged condition by the radioactive energy may be called as a whole an "Atomic Bomb Radiation Injury" or an "Atomic Bomb Radiation Sickness". We would not like to agree here that only a pure (rather theoretical) damaged condition by radioactive energy is picked out and called "Atomic Bomb Injury". It can also not be agreed that the burns, caused by the atomic bomb be placed outside of the category of the so-called atomic bomb injury, because they are produced by the action of heat energy. On account of the blood pictures 4 - 6 weeks after bombing, i.e. a decrease of the granular cells, some investigators suggest classifying the change of blood caused by the atomic bomb damage as an "Agranulocytosis". Some of them, moreover, would like to designate only such "Agranulocytosis" cases as a "pure atomic bomb injury". These opinions are not rational because they are not based on observation and consideration of the whole picture.

The above mentioned "Atomic Bomb Radiation Injury" is the primary damage; there is another type of radioactive effect, called the secondary damage. The secondary damage is caused on the one hand by the radioactive energies (mainly beta-rays) from all elements which are induced by neutrons at the time of explosion and on the other hand by the radioactive energies produced by fission fragments fallen on the ground. The degree of the secondary damage is of course very small compared with the primary one, but it shall be touched upon. We will describe it afterwards in the chapter on problems of contamination.

4) The Atomic Bomb Injury

The injurious forces, produced by the explosion of the atomic bomb, are classified as mentioned above, into the following 3 kinds: 1, thermal energy, 2, mechanical energy, 3, radioactive energy.

These 3 powers are able to cause respectively their own characteristic damage, but these powers will act actually in combination as a whole at the time of the explosion, and will produce a very complicated damaged condition.

For these reasons, we would like to call such a pathologic condition as a whole an "Atomic Bomb Disease". These two terms are used in the same meaning. Every one can use either term, according to his taste. I, myself, use the term "Atomic Bomb Injury," because I think the atomic bomb is to be a new type of powerful weapon.

To observe separately the various kinds of damage produced by the various forces of the atomic bomb, it may be convenient that each damaged condition be designated as follows: Atomic bomb burn, Atomic bomb wound, Atomic bomb radiation injury (or Atomic bomb radiation sickness) etc. These pathologic conditions, even though they may be concerned with burns, mechanical wounds or radiation injuries respectively, are all quite characteristic. They have their own specific features, caused by the effects of the atomic bomb.

For convenience in understanding the pathologic conditions of human bodies caused by the effects of the atomic bomb, we would like to summarize them in the following table:

Atomic Bomb Injury (Atomic Bomb Disease).

I. Atomic Bomb Burn.

1) Primary Burn : Flash Burn.

2) Secondary Burn : Scorch Burn, Contact Burn, Flame Burn.

II. Atomic Bomb Wound.

1) Primary Injury : Blast Injury

2) Secondary Injury: Burial Injury, Crush Injury, Fragment Injury

III. Atomic Bomb Radiation Injury (Atomic Bomb Radiation Sickness).

1) Primary Radiation Injury

2) Secondary Radiation Injury

CHAPTER II.

Clinical Course of the Atomic Bomb Injuries.

Both at Hiroshima and Nagasaki, just at the moment of the explosion of the atomic bomb, darkness and confusion suddenly spread. Devastation of houses, destruction of lives; its terrible scene could never be expressed by either tongue or pen. At Hiroshima, the explosion occurred on August 6th, 1945, at 8:15 a.m., south of the West Parade Ground. At Nagasaki, the explosion occurred 3 days later, on August 9th, 1945, at 11:00 a.m., over the center of the north factory district of the city. The damages in the two cities were not quite the same, on account of the difference of their geographical situation and city conditions. The casualties of the human beings, however, especially the outbreak and course of the atomic bomb injuries were just about the same in both cities.

It would be convenient to understand the clinical course of the atomic bomb injuries, if they are divided into the following 4 periods, with medical consideration of the results of the investigation.

(1) The First Period (the early stage)

From directly after the explosion to the end of the second week. This was the period of the most terrible casualties; various violent energies which were produced simultaneously just at the time of the explosion, acted in a combined form, consequently the damages resulted in various symptoms respectively. About nine-tenths of the victims, who would be expected to die of atomic bomb injuries, actually did so in this period. The majority (ca 90%) of the injured persons who were treated at the medical rescue organizations within several days after the explosion were recorded mainly as burned patients.

(2) The Second Period (the middle stage)

From the beginning of the third week to the end of the eighth week. In this period there prevailed many patients with atomic bomb radiation injuries in moderate degree. About one-tenth of the victims who were destined to die, died in this period. Therefore, the 1st and 2nd periods are to be called "the acute period", according to the condition of the clinical course of the atomic bomb injuries.

(3) The Third Period (the late stage)

From the beginning of the third month to the end of the fourth month. In this period, the symptoms of all sufferers were progressing toward recovery, even though the speed or degree of their recovery did not coincide. Few persons died finally, nevertheless, on account of various severe complications. However, it may be at the end of the fourth month, i.e. in the beginning of December, 1945, at both cities, almost all the sufferers had recovered from the physical damages of the atomic bomb. The clinical course of the atomic bomb injuries themselves, therefore, may be said generally to have come to their end.

(4) The Fourth Period (the after stage)

After the fifth month. This is a period of sequalae, various remaining symptoms, due to burns or mechanical wounds (deformities, contractures, keloids etc.), various remaining symptoms caused by the damage of the blood or blood forming organs after the radiation injuries

(anemia, nervousness etc.), various remaining symptoms of disturbances of the sexual organs (male and female sterility). These sequalae and symptoms appeared more manifest since the beginning of this period and have already been partly clarified by our investigation, but most of them are to be studied continuously in the future.

In the following chapters, the course of the atomic bomb injuries in each period will be described.

1) Genesis and Course of the Atomic Bomb Injuries in the First Period (The Early Stage).

The first period is a time from directly after the explosion to the end of the second week, that is, at Hiroshima from August 6th to about the 19th, at Nagasaki from August 9th to about the 22nd.

Tremendous numbers of deaths were recorded by the injurious action of various kinds of unimaginably powerful energy. According to statistical surveys, about 90% of the dead victims are estimated have been killed within 2 weeks. If the total deaths at Hiroshima be calculated provisionally as about 100,000 90% of them - about 90,000 persons lost their lives in this period.

Immediate deaths are blasted, burned, crushed, drowned etc. The ratio of the immediate deaths (including the deaths within 1 - 2 days) was estimated at 80 - 100% in the area of a radius of 500 m from the gound center, 50 - 80% in the area of a radius of 500 - 1,000 m. Among the cadavers of the immediate deaths, there were many cases with severe generalized burns (charred necrotic skin flaps were loose and hanging), general blast injuries and crush deaths under devasted houses etc. Some severely crushed wounded were burned to death by fires. Besides these, there were found also some cadavers which had apparently no wounds on the surface of the body. They were immediate deaths due to the blast action. It has been argued for a long time that the eye sacks or intestines could be prolapsed simply by a blast action. We have understood that by blast action of an ordinary bomb, a prolapse of eye sack or intestine will not occur without accompanying mechanical wounds. The blast pressure of the atomic bomb, however, is so tremendously strong, therefore lacerations or wounds of the surface tissues would combine with the injuries of internal organs. Medical personnel who worked with rescue organizations told us that few cadavers had true prolapse of internal organs, especially of intestines. The cadavers which appeared as though they had prolapse of the internal organs might have been those with skin flaps torn by hyperthermal blast, combined with complicated open wounds. The alleged prolapse of eye sacks was also probably due to edematous changes of the palpebrae or postmorten prolapse of the palpebral mucous membrane. We can refer to an official report from the KURE Naval Station (the 3rd official report, dated on August 11), which said that there were absolutely no cases of prolapse of intestines or eyes, no hemoptysis, even in the central district, a description in the previous report that there were some cases, based upon false observations on complicated wounds or postmortem changes.

Even in the central area a few persons survived just at the inner corner of a cave (a sideway type, covered by a layer of soil 3 m thick).

Some were also safe in a well covered inside room of a strong concrete building. Some persons escaped from their wooden houses, even in the area of a radius of 500 - 1,000 m from the ground center. Of course their houses were destroyed totally, but they had tried to escape by their own effort from the devastated ruin without any serious mechanical wounds before the fires destroyed their houses.

All persons who were at the time of the explosion within 4 km of the ground center, had burn injuries, except those who were in some shadow. Within a radius of 1 km severe burns, in the area of a radius 1 - 2 km moderate burns, in 2 - 4 km slight burns were observed.

Among the severely burned patients who suffered in the central district, there were many immediate deaths or nearly so, due to direct heat damage of internal organs. Their shirts and single clothes (YUKATA - Japanese summer cloth) were burned or scorched and blown off by the subsequent blast pressure, uncovered areas of skin were burned severely, torn off or left hanging in strips and flaps. The persons with thicker clothes escaped from severe burning in a large area, but those patients died without exception if the ratio of the severely burned area of skin was over 20%.

Every report of the Rescue Corps of the Army and Navy at that time said: "the mortality of the burned patients was very high, among the burns which were treated from the night of the day of bombing to the second day, the mortality was estimated at 20 - 40%". All early reports pointed out that the mortality was relatively high, considering the local appearance of the burned wounds. It was also reported that in several hours after the bombing, many burned patients complained of fever, thirst, vomiting etc. These symptoms were due on the one hand to the effects of radioactive energy and on the other hand to poisonous substances produced in the central area after the explosion. These burned patients showed various different symptoms from pure effects of heat. In the area in which radioactive energy is strongly applied: that is, within a radius of 2 km from the ground center, all burned patients who received a primary burn (flash burn), would expect to have radioactive damage also. Therefore, the burns within a radius of 2 km possessed special characteristics of the so-called "Atomic Bomb Burn".

In the area within a radius of 2 - 4 km, there were observed many patients, burned mainly by radiant heat and light rays. Within 2 - 3 km, there were many cases of scorch burns, due to scorching of their clothes, also many cases of contact burns, due to heating of their clothes. Within a radius of 3 - 4 km many cases of slight flash burn were observed.

The so-called "Atomic Bomb Burn", cases which were caused by the direct impact of both radiation and emission forces, had very poor prognosis. Among about 20,000 cases which were treated in a rescue hospital of the Japanese Marine Corps at UJINA-MACHI, Hiroshima City, 2,623 deaths were recorded, most of them were severe burn cases. About 75% of the deaths died by the end of the first week. Over 90% of the cases died within 2 weeks.

How were the radiation injuries in the first period? In the central area, within a radius of 1 km, the persons who were outdoors had severe effects from radioactive energy and severe burns. Almost all of these

persons lost their lives therefore either immediately or shortly thereafter, as it was explained in the chapter on burn. If a person was in a sufficient shadow, to be protected from heat rays, he had no burn. But he received severe effects of radioactive energy. It has been discussed many times, immediate death or not. The note of Dr. NAGAI's, Assistant Professor of Radiology, Nagasaki Medical College said: "the patients died within several hours, changing the skin into black colour." There may be therefore a possibility of an immediate death (death within several hours after the bomb), due to direct effects of the radioactive energy alone. But it is not sure, for death might be caused partly by the blast action.

Some persons were outdoors in shadows, so they had severe effects of the radioactive energy, but no severe burn. Those persons complained immediately of extreme fatigue, nausea and vomiting, and within a few days various hemorrhagic symptoms such a hemoptysis, hematemesis, hematorrhoea, hematuria etc. occurred. Many of them died finally of general exhaustion. Some persons were within the area of a radius of 500 m from the ground center, but escaped from immediate death, as they were in covered trenches or strong buildings. Some were in wooden houses in the area of a radius of 500 - 1,000 m, and were not killed immediately. These persons complained in several days or in 2 weeks, of fever (38 - 39°C) continuously) and hemorrhage (hematemesis, hematorrhoea, gingival bleeding etc.) Almost all of them finally died. Among these persons, there were many patients who had mucous bloody stools and died. It was thought, therefore, at that time that there prevailed an epidemic outbreak of dysentery like disease. Bacteriological examinations revealed that the majority of these cases proved negative. But at that time, there were really a few cases of true dysentery and typhoid fever. These cases of dysentery and typhoid fever were treated under such confusing circumstances as cases of the atomic bomb injuries. On the occasion of surveys, it was difficult to determine positively secondary radiation injuries (caused by induced radioactive energy), for there were many rumours reported through careless talk.

Many persons in the central district, were effected with vomiting, diarrhoea, anorexia etc. These symptoms may be explained as early symptoms of radiation injury. In the Hiroshima districts the citizens believe firmly the following stories. These various symptoms occurred after the explosion and were caused by aspiration of some gas-like substances or by drinking water, in which these substances were dissolved. We can not thoughtlessly deny these stories, because we have not enough evidence that these stories are to be negativated. Nevertheless, we have had until now no positive data upon which to support these stories.

2) The Course of the Atomic Bomb Injuries in the Second Period (The Middle Stage).

The second period extends from the beginning of the third week to the end of the eighth week, that is from about August 20th to the beginning of October, 1945, the period of about 6 weeks, both at Hiroshima and Nagasaki. This period can be divided into two sub-periods, according to the clinical course of the patients; the early sub-period (the 3rd, the 4th and 5th week - from about August 20th to September 10th) and the late sub-period (the 6th, the 7th and 8th week - from about September 10th to the beginning of October.)

The majority of the cases which had severe atomic bomb burns, lost their lives during the first period. Therefore, the burned patients surviving until the early sub-period of the second period, were moderately or slightly affected cases. The persons who were within a radius of 2 km from the ground center, had flash burns, combined with scorch - contact - or flame burns. These burn wounds were all of the 3rd degree, the damage penetrating into the deep layer of the skin. Therefore, the demarcation of the necrotic tissue takes a longer time. These patients also suffered from radioactive sickness. According to the alternation of the tissue reactions, the healing process of the wounds were prolonged. The less resistance against infection caused severe suppuration of the burned wounds. The shortage of medical rescue organizations and medical supplies was also a detrimental influence upon the healing of the wounds. Many patients had suffered from severe cicatrication, which would be ground for the further formation of contracture or keloid. On account of the suppuration and disturbance of the healing of the burned wounds, some patients had fallen into a general weakness and showed a poor prognosis. There were observed many slight flash burn cases in the area of a radius of 2 - 4 km, especially at a distance over 3 km, many of these burned cases were just superficial flash burns, which had been almost cured within early subperiod.

Among those wounded mechanically, many severe cases had died in the first period. Slightly wounded cases had been cured for the most part by the end of the late subperiod. The burned cases also healed without suppuration, when they were affected slightly in the area of a radius of 2 - 4 km, glass wounds had also healed very quickly without suppuration, when it occurred in the area of a radius of 2 - 4 km.

On the other hand, those wounded in the houses, within a radius of 2 km, were affected severely and tended to be infected. Healing was prolonged. It should be understood that these patients were affected at the same time by the radioactivity and had radiation injury.

The persons who were outdoors and yet in some shadow, or who were in wooden houses within a radius of 1.5 km from the ground center, had neither burn nor wounds, but they were affected moderately by the radioactivity. Many of them complained, as above mentioned, of vomiting in several hours after the bomb and of anorexia for several days. These persons were, however, becoming better and recovered within several days. Some of them could work at rescue labor. Almost all persons who were within a distance of 1 km from the ground center, were becoming ill in the 3rd or 4th week. Epilation, fever, hemorrhage, necrosis, mucous bloody stools etc. About $\frac{1}{2}$ of the cases died in the course of one week. About $\frac{1}{4}$ of the cases died of complications later.

About one half of the persons who were affected at a distance over 1 km up to 2 km became ill in the 4th and 5th week. They showed epilation, fever, hemorrhage etc. Some of them died of complications in the late subperiod. These patients often became ill without apparent reason, but some of them marked their onset by: overwork, cold, digestive disturbance etc.

In the late subperiod, there occurred some complications of radiation injuries. Many cases were observed, in which some hemorrhagic and necrotic foci were combined with infections: cellulitis, pneumonia, abscess of lungs, gangrene of lung, empyema, enteritis, and especially colitis gravis etc. With these infectious complications the general condition of

the patients again became worse. The occurrence of these complications was based upon the weakened resistance against infection, due to the radiation injuries. On account of the alteration of tissue reactions against an infection, the symptoms of these complications appeared very often in a strange atypical style.

At the end of the late subperiod of the second period, many patients in severe condition showed some signs of recovery. The destructive processes of the atomic bomb injuries ceased at the end of the second period. At that time the clinical course of the atomic bomb patients was going into a recovery stage, the 3rd period.

3) The Course of the Atomic Bomb Injuries in the Third Period (The Late Stage).

The third period is from the beginning of the third month to the end of the fourth month, that is from the beginning of October to the beginning of December. All damaged conditions of the human body took the course of recovery in this period. Even the mechanical wounds or burns which had showed prolonged healing until this time, showed a remarkable healing tendency demonstrating the recovery of function of the blood and internal organs. These wounds had mostly healed by the end of the third period and by that time various sequelae were observed: contracture of the scar, formation of keloid, aneurysma etc. It has not been determined yet, if these sequelae are especially common in atomic bomb patients. We are interested now in the question as to whether those severely wounded by other types of bombs have such a high rate of sequelae. Further experience may give us answer.

The symptoms of the atomic bomb injury also improved in this period: The symptoms of epilation had ceased since the late subperiod of the second period. In many epilation cases, the growing of some thin sparse hairs was observed at the beginning of the third period.

Slight cases of epilation had almost recovered by the end of the third period. In severe cases of epilation, new hair was finally growing.

The damage to blood also recovered in this period. The clinical examinations revealed that leucocytes recovered first. By the end of the fourth month, the number of white blood corpuscles generally returned to the normal value. Some of them even showed somewhat of a leucocytosis. In these cases the recovery of granulocytes was more remarkable than that of lymphocytes. Many cases were observed, who showed a comparative increase of eosinophilic granulocytes. Eosinophilia is a temporal symptom, which is used to indicate a better prognosis.

The observations in the first and second periods revealed to us that the damage to red blood corpuscles was slighter than that of white blood corpuscles. Some cases showed a severe damage to red blood corpuscles in the third period, especially in the cases which had general weakness, caused by the prolonged healing of burns, or in the cases which had some general disorder, caused by complications. In all these cases it was proved that the damage to red blood corpuscles proceeded further in this period.

Put on the whole, the damage to red blood corpuscles also recovered in the third period. The condition of recovery of red blood corpuscles, generally speaking, followed that of white. Even in the fourth month, some cases had not yet returned to the normal value. There still remained many cases of anemia.

Bone marrow showed a proliferative picture, both in granulocyte and erythrocyte systems.

Many patients recovered in the third period. The typical appearance of the face, observed in the second period - anemic, edematous and cachectic features - gradually faded away. An active vivid appearance came back to the face of the patients. A few patients could not, however, completely get back their general healthy condition, because of the prolonged wound healing and the occurrence of the complications, especially suppurative ones.

On this occasion, we would like to touch upon a special feature of some patients, which are provisionally called, "a cachectic condition". This cachectic condition of patients is characterized by a progressive consumption, a dryness of mucous membrane, often sub-icterus, an edema of the various parts of the body, sometimes an ascites, severe diarrhea etc. They usually have distinct anemic features. Disturbances of the function of the liver and the kidneys also occurred. These patients had neither incurable wounds nor suppurative complications. If they had some wounds, their local conditions became worse and they had no tendency to heal. The patients who had such severe symptoms, did not respond to treatment and passed away finally. Among 141 cases of severe atomic bomb injuries who were treated at the SHINKOZEIY Hospital, Nagasaki, there were observed 15 cases of typical cachectic condition and 7 cases of tendency to it in October and November, 1945. This condition looked like mal-nutrition, so some investigators said, due to a disharmony of nutrition. The fundamental basis of this condition should be damage of the functions of internal organs, due to atomic bomb injury. We would like to consider an atomic bomb injury as a wound in a wide sense, therefore we called this condition provisionally "a cachectic condition" in the same meaning as "a wound cachexia", which is given to a condition, occurring in the course of severe wounds. These cachectic conditions are curable in cases of not too severe a grade. Recovery occurs when the function of internal organs comes back with the elapse of time.

It is a well known fact that the sexual organs are affected remarkably by the radioactive energies. A study in the third period at Hiroshima revealed the following results: Out of 124 investigated cases, it was shown that in 43 cases (34.7%) the number of spermacytes in the ejaculated sperm was under 5,000 in one cubic mm (absolutely sterile), 10 cases (8.1 %) 5,000 - 10,000 (relatively sterile) and 71 cases (57.1%) over 10,000 (normal). About 1/3 cases of all investigated persons were estimated therefore to be in a sterile condition. A reformation of the spermacytes occurs in one month, so the recovery of damage to spermacyte formation will be delayed more than that of the damage of white blood cells. The shorter the distance, the more severe was the damage. The damaging influence on the number of spermacytes was observed in the area within a radius of 3 km from the ground center. Within a radius of 2.5 km there appeared some sterile cases, within a radius of 1.5 km one half of the cases showed sterility.

The results of an investigation of the menstruation of the females at Hiroshima was as follows: Among 399 women in the ages of sexual maturity, 121 cases (30.3%) had normal menstruation even after the bomb, the other 278 cases (69.7%) showed some disorders of menstruation, mostly amenorrhoea. The nearer the distance, the higher the ratio of menstrual abnormality. According to the further studies on the cases which had some abnormality of menstruation, over 80% of the cases of temporal amenorrhoea recovered in 2 - 6 months and they again had normal menstruation. Moreover, several cases had already been recognized as pregnant.

We consulted 35 pregnant women, who were over the 2nd lunar month at the time of the explosion. Among them 2 abortions were reported, one case on the day after the explosion, another after 3 weeks, the latter probably due to diarrhoea. The other women have been getting along well. 14 cases have delivered already without any particular abnormality throughout both labour and puerperium. In new borns, we have noticed nothing abnormal. As to the endometrium of amenorrhoea cases, the estimated phase at the bombed time did not correspond to the actual phase shown by the curetted specimens. Many of them showed the beginning or middle stadium of post menstrual phase. The endometrium itself was generally thin and atrophic. In the recovered cases, the estimated phase and the phase diagnosed by the curetted specimens corresponded well.

4) Sequalae of the Atomic Bomb Injuries in the Fourth Period (The After Stage).

Both at Hiroshima and Nagasaki, in the fifth month, i.e. in the beginning of December, 1945, the effects of the atomic bomb upon the human body had almost all passed away. Therefore, after the fourth period, the few remaining sequelae are to be studied.

The sequelae of burns and mechanical wounds are contractures and keloids of the scars, disorders after the injuries of peripheral nerves, aneurysms of the blood vessels etc. In some rare cases we might consider the possible genesis of cancerous changes in the scars of burned wounds. The rate of the formation of these sequelae will become clear by further observations. We have not yet received any reports which reveal some distinct differences in the atomic bomb wounds compared with the sequelae after the damage caused by ordinary bombs.

Among the symptoms of radiation injuries, all the epilation has recovered. The hair began to grow again, at the latest by the beginning of the fourth period. The regrowing hairs seem to be generally thin and sparse. Further study will tell us how completely the damage of hairs will recover and for how long recovery will occur.

The damage to blood recovered almost completely by the end of the third period, as above mentioned. There remains even yet some cases of anemia (hemoglobin content around 50%) and leucocytosis (around 15,000). The cases who showed leucocytosis in this period, were mostly outside of a radius of 2.5 km from the ground center at the time of bombing.

In the further studies, it was proved that the anemia recovered very slowly. There may occur, therefore, some disturbance in the form of anemia.

A condition of leucocytosis is thought by many investigators as a

phenomenon of temporal regeneration, but in bone marrow a remarkable picture of proliferation was seen, consequently it is necessary to watch the further course, until it comes back to a normal condition. It is noteworthy that one sufferer at Nagasaki (at 1 km from the ground center) died with acute leukemia after 3 months. The patient was a male student, 19 years of age. In the end of August he had the clear symptoms of radiation injury. His white corpuscles were counted at 650 as a minimum. He was treated at the University Hospital, FUKUOKA, and recovered fortunately in one month. In the beginning of November, after a heavy harvest labor in a 3 day period he became suddenly ill with high fever and severe hemorrhage. The white count was 390,000. He died in 5 days. Clinically he was diagnosed as an acute monocytes leukemia and it was proved by autopsy (cf. the report of Dr. MISAO's, Medical Clinic, Kyushu Imperial University). Since then we have not yet heard of any similar cases, but we shall not assume that this case might be an accident one.

As far as the symptoms of the atomic bomb radiation injuries are concerned, many investigations were done from various points of view: biochemical and immunological studies on blood, studies on the status and functions of the digestive tract, studies on the functions of liver and kidney, studies on functions of blood capillaries etc. All these features had some disorders more or less after the bomb, but most of them recovered by the end of the third period. Nevertheless, these features showed a little abnormality or deficiency in their characters, conditions or functions, so the function of an organism as a whole, in other words, the resistance power of the whole body shall be estimated in a less functional condition. We must follow up this condition in some period as an after effect of the atomic bomb injuries and not forget to give suitable care.

On the psychological side, the situation may be similar. Special mal-effects have not yet been reported, but we must be always very careful about neurosis-like complaints in connection with the present social circumstances. This aspect has, of course, some close relation with the anemia as well as lower resistance of the whole vital power of the patients.

The damage of the sexual functions was described already, the latest survey revealed that the abnormality of menstruations of the females recovered almost entirely, and that the recovering of the decreased number of spermatocytes in males is a little slower. A further study has been requested.

The women who were in an early stage of pregnancy, have taken a normal course since the bombing. New born must be carefully checked upon, in order to make clear, how they come along, because they were given a relatively large dose of radioactive energy in their earliest fetal life.

It is already experimentally proved both in botany and zoology that there is a possibility of producing a malformation of descendants, when the sexual cells are affected in some degree by radioactive energy. The question, if this fact is applicable to the human beings or not, will be made clear by the further observations. We have already clear evidence that the human sexual cells are also affected by the atomic bomb injuries. There is a possibility of malformation of the descendants, if the sexual cells should be affected selectively, without any severe damage to the other organs or tissues. In the survey of spermatocytes, it was noticed that they

decreased not only in their number, but they showed also some structural abnormalities. This problem must be, therefore, taken up and carefully followed further. Moreover, if necessary, it shall be discussed also in the field of study of heredity and eugenics.

CHAPTER III

Damages and Casualties by the Atomic Bomb

1. Damages to the City.

Some abstracts about the damages of the buildings will be at first pointed out, which are the basis for the surveys of the human casualties.

The survey at the Hiroshima district told us as follows: All wooden houses within a radius of 1 km from the ground center, were pulverized in an instant; wooden houses in the area between radii of 1 - 2 km were devastated totally: those in 2 - 3 km were destroyed severely; those in 3 - 4 km were damage moderately. A severe destruction of the houses means a damaged condition in which nobody can live further. The floor mats were even blown up. Moderate damage means the houses are scarcely available to live in, for all doors and windows are blown off. The roof tiles slip down and the roof leaks heavily. The damage to doors and windows is seen up to 6 km. Slipping down of roof tiles up to 8 km. Breaking of the window glasses extends to around 16 km.

All concrete buildings are more resistant, even in the central area, for only upper roofs are damaged. All furnishings were stirred up completely. Outside a radius of 1 km from the ground center, there are almost no damage in a concrete building. All window glass was blown out to a distance of 2 km, and window frames toward the explosion center were also destroyed.

The fires caught all wood and concrete buildings in the area within a radius of 1 km from the ground center. The wooden houses were burned for the most part, in the area between radii of 1 - 2 km, partly burned in the area of 2 - 3 km. Some of the well constructed concrete buildings partially escaped from the fires, even in the area within a radius of 1 km from the ground center.

The official survey of the Hiroshima Prefecture revealed the total number of houses in the city of Hiroshima before the bombing to be 75,000; out of them 55,000 were totally burned (including totally destroyed and burned, and partially destroyed and totally burned), 12,600 partially burned, 6,820 totally destroyed, 3,750 partially destroyed. All damaged houses were counted and found to total 68,170, that is over 90% of all houses.

In the Nagasaki district, the destructive power seemed to be far greater. There are mountain chains running in a south-north direction, at both east and west sides of the bomb center. On the bombed side of the mountains the damage was more severe, behind them, it was slighter.

At Nagasaki, in the central area, all iron framed, slate or zinc covered factory plants were destroyed; roofs and walls were broken off, iron frames were also deformed and some of them twisted like jelly. This may be due to an influence of the fires too.

The Nagasaki Prefecture reported: 11,494 houses were totally burned, 2,652 houses totally destroyed (escaped from the fires), 5,441 houses

partially destroyed.

2. Statistics of the Sufferers.

Both at Hiroshima and Nagasaki, the actual population at the time of the bombing was not known for sure, because of evacuation of citizens, forced enlistment of workers into military factories, voluntary service of pupils and students, movement of military forces, etc. The exact data of casualties is not, therefore, well known. The following confusion at the war end made the estimation very difficult, despite all efforts from various sides.

The Hiroshima Prefecture reported, on August 25, 1945, (at the end of the 3rd week): 46,185 deaths, 17,429 missing, 19,691 severely injured, 44,979 slightly injured, 235,656 suffered, and in total 363,940 casualties. The report dated February 2, 1946, (after 6 months): 78,150 deaths, 13,983 missing, 9,428 severely injured, 27,997 slightly injured, 176,987 suffered, and in total 306,545. Out of the above calculations, 78,150 deaths and 13,983 missing are summed up in total to 92,133. As this number does not include the number of dead of the military forces - the total number of the death cases at Hiroshima will be estimated around 100,000.

The Nagasaki Prefecture reported the casualties on August 31, 1945. The number of the dead cases (examined officially) was 19,748, missing 1,924, wounded 40,993, and in total 62,665. The report on October 23, 1945: deaths 23,753, missing 1,924, wounded 23,345, suffered 89,025, and in total 138,805.

Dr. M. MASUYAMA, member of the Faculty of Medicine, Tokyo Imp. Univ. and Institute for the Statistical and Mathematical Studies, Educational Ministry, made a careful statistical survey on each of 6,000 families at Hiroshima in December 1945, and at Nagasaki in January, 1946, in collaboration with Lt. M. E. HABEL, member of the American Commission for the Investigation of the Effects of the Atomic Bomb. Excepting the military casualties, he estimated the number of dead at Hiroshima would be between a maximum of 63,670 and a minimum of 58,580, the number of wounded between a maximum of 72,880 and minimum of 68,810. At Nagasaki, he counted the number of dead, being between a maximum of 37,507 and a minimum of 29,398, and the number of wounded between a maximum of 26,709 and a minimum of 23,469. The calculated values seem to be lower, compared with those of other sources. The reason is based upon the elimination of uncertain cases and upon the count of exact cases which were directly affected by the atomic bomb.

Dr. MASUYAMA made also another survey on the death date rate, in viewing the official death records at the KABE Police Station, Hiroshima Prefecture. Daily increase of the total death number was indicated in a curve of an exponential function. Death rate diminished in a half value in about every 6 days. In other words, about 50% of all dying victims died by the 6th day, 25% died from the 7th to 12th day. By the 40th day after the bombing, over 99% of the dead cases have lost their lives. KABE is a small town, located about 15 km north from Hiroshima and along the KABE local railroad line. After August 6th many injured were transported to KABE. 331 deaths were recorded in 40 days until

September 14. The death rate survey at this town shall be understood, therefore, to be based upon the observations of those cases only, which could escape themselves from the disaster at Hiroshima, and the observations did not extend to the cases of immediate death or to the most severely wounded, who had lost their lives at the bombed places.

The same observations were also made at Nagasaki by Dr. MASUYAMA, in viewing the official death records at the Prefectural Police Station. The death cases on the first day were omitted, because their number was very large and it would contain some uncertain figures. The death date rate since the 2nd day could be shown in a similar curve, as that of KABE cases.

The dead cases on the first day of the atomic bomb explosion, are counted in an unimaginably large number. The immediate death rate will depend upon certain specific relation. In this aspect we will discuss again the deaths from a different stand point in the following paragraph.

At Hiroshima the survey of death rates, in distances from the ground center by Dr. MASUYAMA revealed the death rates diminished according to the increasing of distance from the ground center. In the area within a radius of 0.5 km from the ground center, the mortality is practically 100%, at a distance of about 1 km around 80%, at about 1.5 km around 40 - 30%, and at about 2 km around 20 - 10%. The death rate almost corresponds to a calculated curve which is drawn as a killing energy, diminishing inversely proportional to the square of distance.

Comparing the death rates of males and females, we find they are almost equal outside a radius of 1.5 km from the ground center, but the rate of females within a radius of 1 km seems to be lower than that of males. While we were staying at Hiroshima, we often heard that under the same conditions, men died more quickly, women were more resistant. We could not believe such a story at that time. But the statistics showed a result that in the central area, the female mortality seemed to be a little lower than the male. The reason for this fact is of course unknown. The central area, within a radius of 1 km, was the place in which a tremendous number of neutrons reacted. We may be allowed to imagine that a difference of distribution of the atomic energies would cause the difference in the death rates between males and females.

Isomortality curves on a map of Hiroshima City trace almost isocentric circles. Slight deviations are recorded. Generally speaking, the curves expand a little in south and south-south-west directions and contract a little in east and south-east directions. In a south-south-west direction there are several rivers flowing into the sea, so the injuring energy would be distributed more heavily in this direction. In east and south-east directions there are many strong concrete buildings and a few hills (HIJI-YAMA and others), so the injurious energy would be reduced a little.

3. Statistics of Casualties in the Special Groups.

The army reports revealed the casualties of the troops of the CHUGOKU Regional Army (Middle Land District Army), dated on August 20, 1945. Among 7,624 soldiers in total: dead 534, missing 2,704, injured 2,713, not injured 1,668. This is valuable data because it showed the total casualties

in the first period (from directly after the bombing to the end of the second week). If the missings were counted as deaths, the estimated deaths were 3,243. Therefore, the rates of death and injured are respectively 42.5% and 35.6%. These troops were located at various places, the majority of them were in the area between a radius of 0.5 - 2.0 km from the ground center and most of the soldiers were working outdoors.

The casualties among the pupils of the elemental and high schools in the city of Hiroshima were surveyed from the beginning of September to the middle of October, 1945. The total investigated number was 16,938. Dead and missing together 4,312 (25.5%), injured 1,603 (9.5%). The mortality in each distance from the ground center, is as follows: in the area within a radius of 1 km, 82.8%, in the area between radii of 1 - 2 km, 26.0%, in 2 - 3 km area 1.9%, and in 3 - 4 km area 0.5%. This record will contain almost all of the dead cases, because it was counted in the early sub-period of the second period.

The casualties of many school parties and public service parties at Hiroshima, which were working outdoors, were also investigated. Some data will be abstracted here.

Out of 87 members of a public service party from OTAKE-town, who were working outdoors to help in evacuation of houses at 0.9 km west from the ground center, 80 died on the first day, 3 died in the first week, and the other 3 died later. The mortality 100%.

Therefore, we would like to conclude that by the direct primary effects outdoors within 1 km, the mortality is 100%, the majority of dead victims passing away in the first week.

Another 3 service parties from OTAKE-town were beside the TEHMA bridge, at 1.1 km west from the ground center. KUBA-village team was working on a river bank to transport roof tiles to a boat. Out of 106 members, 48 died on the first day, 38 died in the first week, 10 died in the second week. Another 10 persons suffered from radiation injury, but survived. The mortality 90%. MORIMOTO and NAGATO teams were taking a rest on the street. The MORIMOTO team was in the shadow of one-story wooden houses, and the NAGATO team was in the shadow of 2-story wooden houses. The majority of the members of both teams had neither burn nor wound, except a few who died by crushing under the destroyed houses. All members showed symptoms of radiation injuries after 3 weeks and many deaths occurred. In the MORIMOTO team there was an 84.0% mortality, and in the NAGATO team a 47.2% mortality.

It is clear, therfore, that at a distance of about 1 km, outdoors in some shadow, the rate of casualty will become considerably lower, but about one half of the number of persons will die of radiation injury.

Another team of OTAKE-town party was marching on a street, at a distance of 2.3 km west, toward the ground center. The total of 580 members had burns, except 3. 7 burned and 2 wounded persons died (mortality 1.6%). Others suffered from flash burns of moderate or slight grade and all healed.

Now some data of the casualties in wooden buildings will be

abstracted. The Hiroshima First Army Hospital was situated around 0.5 km north from the ground center and built of wood. Among 750 persons who were in the hospital at the explosion, only one escaped from death. The mortality was 99.9%. The majority, (around 4/5) of the dead, died early, the other 1/5 died later.

The Hiroshima Second Army Hospital was a one-story wooden building, located at around 1 km north from the ground center. Out of 402 persons who were in the hospital, 303 died, the mortality being 75.3%. Among the dead victims, 90 were immediate deaths, and 213 later deaths.

Some abstracts from the casualties in the strong concrete buildings at Hiroshima will follow. At the Banker's Club, located at 0.2 km from the ground center, 36 immediate deaths were noticed, and 28 died in 6 - 25 days after the bombing by radiation injuries. 2 survived. The mortality was 97%.

The branch office of the Nippon Bank, located at 0.4 km south-east, was a 3-story concrete building. Out of the total of 75 members, the dead victims were counted as 43 (57.4%). About 2/3 of the survivors showed symptoms of radiation injury.

There were 150 persons in the Central Telephone Office (7-story concrete building), located at 0.5 km south-east from the ground center. 183 persons were working in the CHUGOKU Electric Co. (5-story concrete building) at 0.8 km south from the ground center. In both buildings, the mortality was over 30%. Just about half of the survivors suffered from radiation injury.

The FUKUROMACHI Telephone Office was at a distance of 0.9 km south-east, and was a seven-story concrete building. 95 persons were working in this building. Many of them were on upper floor, which had many windows and faced toward the explosion center. 36 immediate deaths and 53 later deaths occurred, 87 deaths in total. The mortality was 93.7%.

At the Radio Station (2-story concrete), 1.0 km east, and at the Post Office Bureau (4-story concrete), 1.4 km north; the rates of dead and injured are respectively 6% and 2 - 10%. A few among the survivors complained of radiation injury.

The main building of the Hiroshima Red Cross Hospital was a 3-story concrete building and located at a distance of 2 km south from the ground center. In accessory wooden buildings many cases of deaths and injuries occurred, but in the main concrete building there were only 2 deaths. The majority of the total of 480 members in the concrete building were injured by broken window glass, window frames, furniture and equipment etc. Many glass wounds occurred. In this hospital some window curtains and chair covers were scorched and had their colors changed by heat rays. X-ray films in storage, even in a lead chamber, were affected by radioactive energies and were exposed as revealed by development. So it was estimated that a comparatively large dose of heat, light and radiation rays reached that point. Nevertheless, no single case of radiation injury was observed in the main concrete building.

As above mentioned, the grade of damages in a concrete building is surely slighter, compared with those in a wood house. But this can apply only in a well covered part of the under floors. Besides the window danger of upper floors, there are such as broken glasses.

The surveys at Nagasaki have demonstrated the same results. 50 persons were working to arrange sewage in a cave trench of a hill beside the Nagasaki Prison, just under the explosion center. 7 persons among them, who were in a deepest corner, survived. The other 43 died at their post.

As the factory district was bombed at Nagasaki, special surveys on the casualties of the factory workers were performed. The factories of the MITSUBISHI Steel Works are located at a distance of 0.6 - 1.0 km south from the ground center. Most of them were made of iron-framed, slate-roofed, and partly of concrete. Among the total employees, 1,721 on the bombed day, 883 were dead by September 15, the death rate 51.2%; by October 15, 915, 53.0%.

The MORIMACHI plant of the MITSUBISHI Arms Works was situated at a distance of 1.0 - 1.5 km south and were built partly of concrete, partly of iron-framed, slate-roofed. Out of a total of 2,200 workers, 170 were dead by September 1, a rate of 7.7%; by October 1, 600 - a rate of 27.2%. The OHASHI plant of the same works was at a distance of 1.2 - 1.7 km north, and was of a similar construction. Among a total of 6,028 employees, deaths by September 15, was 479, a death rate of 7.9%; by October 15, deaths 1,200, a rate of 19.9%. When the rate of these casualties was considered separately in concrete and iron-framed, slate roofed buildings, the casualties in the former, of course, was far smaller than those in the latter.

4. General View of the Atomic Bomb Injuries.

In the order to make clearer the general aspects of the atomic bomb injuries at Hiroshima, the Medical Parties of the Medical Faculty, Tokyo Imperial University, performed a special survey in the middle of November, 1945, selecting 28 places at random in the area within a radius of 2 km from the ground center. At each place, they selected several families, which were living there at the time of the explosion and asked carefully about all members of their families. Judging and classifying by their medical common sense, exact data concerning 898 persons was obtained. Some interesting results will be here abstracted.

There were 507 deaths among 898 persons. The death rates at each distance are as follows: In the area within a radius of 0.5 km, 98.4%; in the area between radii of 0.6 - 1.0 km, 90.0%; in the area between radii of 1.1 - 1.5 km, 45.5%; and in the area between radii of 1.6 - 2.0 km, 22.6%. The death rate in the total area within a radius of 2 km, was 56.5%. There were 358 cases of supposed immediate death. The rates of the immediate death were 90.4% in 0 - 0.5 km, 59.4% in 0.6 - 1.0 km, 19.6% in 1.1 - 1.5 km, and 11.1% in 1.6 - 2.0 km. In the total area of a radius of 2 km, the rate of immediate death was 37.0%.

Out of total 507 deaths, we could pick up 487 cases, which were proved to die on some exact date. From this data we can assume the dying

condition of the victims. The number of deaths, which occurred on the bomb day was 358, the rate of the known deaths being 73.5%. Therefore, 73.5% of all dead victims passed away on the bombed day. This fact will tell us how strong the injurious power of the atomic bomb is and also suggested to us how difficult the rescue problem is. This will be discussed later.

Among the dead victims, there were counted 413 deaths by the end of the first week, the rate to the number of total victims being 84.8%. 432 deaths occurred by the end of the second week, the rate 88.7%.

From this data we can see that about 9/10 of all dead victims died within the first period. The other 1/10 of the cases died since the second period. In the second period (the 3rd to 8th week) 48 (9.9%) died. In the third period (the 3rd to the 4th month) 7 (1.4%) died.

From the stand point of rescue, we may say that the first period itself is a most important stage. If effective rescue measures for the victims in the first period could not be achieved, the rescue rate would still stay only 10%, even though all dead victims in the second period could be helped.

The cause of 490 deaths was analyzed; 128 cases (26.2%) were dead on the first day of unknown causes. 223 cases (45.5%) were crushed, pressed and burned. The causes of their deaths were distinctly mechanical, and almost all of them were belonging to the first day deaths. 80 cases (16.3%) died clearly of flash burn. 59 cases (12.0%) died of radiation injury. If we would estimate the 128 first day deaths without clearly defined causes as mechanical deaths, the total number of the mechanical deaths would be over 70%. The problem of mechanical deaths, which has been neglectfully dealt with in the past, has become a most important one now.

Among the investigated 898 persons, there were 400 cases whose injuries were well known, 141 (35.3%) had burns, 241 (60.3%) mechanical wounds and 114 (28.6%) radiation injuries. These figures duplicate, so the total is over 400. If the 204 cases of crushed, pressed and burned deaths were counted also into mechanical injuries, the number of mechanical injuries would be 445. The rate of mechanical injuries to the investigated 604 cases is 73.6%. If 128 first day dead cases of unknown causes were counted also into mechanical injuries, the total number of mechanical wounds would be 573. The rate of mechanical injuries would be 78.3% of the 732 injured persons by various causes.

Among all of the 898 persons investigated, 45 cases had unknown causes of injury. Of the other 853 cases, 573 (67.3%) were injured mechanically. Only 121 cases were not injured at all.

By these surveys, it is known that in the area within a radius of 2 km, about 67% of all attendants were affected mainly mechanical, about 35% mainly by heat energy, about 28% mainly by radioactive energy.

The Medical Parties of the Tokyo Imperial University have done another important survey, that is, careful studies on 5,120 survived cases at Hiroshima in October and November, 1945. Some results from their report will be discussed.

Out of the investigated 5,120 persons, 3,942 were injured and 1,178 not injured. There were 1,881 burn cases, pure primary burns 867, primary and secondary burns 982. The total number of these 2 groups was 1,849 (98.3%) indicating the number of primary burns. There were 32 pure secondary burns. Out of them 17 cases were contact burns (caused by overheated or charred clothes), and 15 cases were flame burns. Among 1,881 burn cases, we have 399 (21.2%) cases with radiation injury, and 1,488 (78.8%) cases without radiation injury.

The mechanical injuries totaled 2,379.

There were 909 cases of radiation injury among them, 399 cases (43.9%) had burns, and 510 cases (56.1%) no burns.

The burns outdoors numbered 1,526 (81.0%), indoors 355 (19.0%).

Mechanical injuries outdoors numbered 466 (19.6%), indoors 1,913 (80.3%). Of the injured persons who were indoors; there were 1,576 (66.2%) in wooden houses, 293 (12.3%) in concrete buildings, and 44 (1.8%) in other places. Just the inverse relation, compared with the burned cases.

The radiation injuries outdoors numbered 421 (46.3%), indoors 488 (53.6%). Of the injured persons who were indoors; in wooden houses there were 392 (43.1%), in concrete buildings 74 (8.1%), and in other places 22 (2.4%).

CHAPTER IV.

Problems in Contamination of the Bombed Area.

Soon after the atomic bomb dropped on Hiroshima and Nagasaki, a strange story was broadcasted from America stating that the bombed area would be contaminated by the action of the atomic bomb and no living thing might grow and live for at least the coming 70 years. Accordingly, we should study carefully, if it is true that a certain area around the ground center of the explosion is really contaminated, in such a grade that animals and plants will not be able to live there for a long time.

Since directly after the affairs, many groups of physicians - Prof. ARAKATSU and others, Kyoto Imp Univ, Prof. ASADA and others, Osaka Imp Univ, Prof. SHINOHARA and others, Kyushu Imp Univ, Dr. NISHINA and others, Institute of Physical and Chemical Research etc. - worked and studied the physical, especially the radiological sides of the problem and collected valuable data. The influence upon the animals and plants, and especially the agricultural plants was also studied by groups of biologists and agriculturists. We medical members investigated the influence upon human beings. The results of these studies have already been presented in part and will be presented in the near future separately. We would like to discuss here the problems of contamination, from the stand point of medical science.

It may be assumed from the various reports that there were remaining injurious factors for several days after the bombing, which might cause some unfavorable effects on the human body. The intensity of the contamination decreased very rapidly in several days. We would like, therefore, to believe that there was no contamination factor after one week strong enough to produce harmful effects upon the human body.

What then were the injurious factors, which might exist in the first few days? The following 2 factors should be considered, according to the results of the surveys which were done until now.

1. Injurious factor by primary fission fragments.
2. Injurious factor by induced radioactivity.

Short abstracts of the results of the investigations concerning these 2 factors will be discussed here.

1. Influence by the Fission Fragments.

At the explosion of an atomic bomb, it is theoretically estimated that the powerful fission fragments will be scattered over a circle of a radius of 80 meters and the weaker fragments in a circle of a radius of 500 meters. These scattered fragments will be blown up in the next instant high into the sky by the blast, reflected from the ground, directly after the explosion, and be scattered away in a huge cloud, which can be seen even from a great distance. No fragments will, therefore, remain on the ground. Careful investigations were made, at both cities, on soil specimens taken at various places. Radioactivity was proved around the ground center, its intensity being very weak, under 10 - 20 times the natural leekage of the electroscopes which is below one hundredth of a tolerance dose. The measured radioactivity decreased rapidly in its intensity with time. It acted

upon human beings at the longest for a period of one week. Some soil specimens at the TAKASU district, west suberb of Hiroshima City (located between KOI Railroad Station and ITSUKAICHI Railroad Station, at a distance of 4.5 km from the ground center), were proved to show the same intensity of radioactivity as that of the ground center. On August 6 there was blowing a weak east-south-east wind, in a velocity of 1 - 2 meters per second. About 20 minutes after the explosion, it rained heavily at the TAKASU district. It was said the rain was black, for it made black spots on white clothes. Consequently it may be estimated that the radioactivity of this district was caused by the fission fragments, which came down by wind and rain. But its intensity was surely very weak, for we have no clear evidence yet that some biological effects have occurred to the human body.

At Nagasaki, there was a west wind and a light rain in the eastern district. Relatively powerful radioactivity was proved at the NISHIYAMA district, at least 3 km from the ground center. This district is located at the eastern foot of MT. KOMPIRA, which stands in the east side of the bombed area. The NISHIYAMA area was protected from the primary rays by Mt. KOMPIRA. In the district (south-north 2 km x east-west 3 km), soil specimens had radioactivity 200 times the natural leakage of the electroscope. A soil specimen under a gutter down spout of a house, which is located just in the center of this district was found to be about 2,000 times the natural leakage. By the physico-chemical analysis, many substances have been found which emitted radioactive energies. The half-lives of the radioactive products were varied, 42 days, 44 days, and 75 days, etc. Beta rays and gamma rays were recognized. 3 kinds of gamma rays were also noticed. Medical surveys on the inhabitants of this district were done, especially on the persons who seemed not to be affected by the primary radiation. After 2 months some persons were found to have leucocytosis. Further study is now being carried on. The first test was performed in the beginning of October, 1945, very many cases of leucocytosis (maximum 25,400 in cmm) were found among the children under 15 years of age. Among the young and adult persons some leucocytosis was also found, but no abnormality was proved among the old persons, over 50 years of age. After 5 months, in the beginning of January, 1946, the fourth test was done. Among adult and old persons, leucocytosis was found too. Now the cases of Leucocytosis among the children were decreasing. These persons with leucocytosis showed no other subjective or objective symptom or signs. The leucocytosis ranged from 20,000 - 40,000 per cmm, the maximum 48,000 per cmm.

This finding may be explained by beta and gamma rays being continuously emitted from the ground, even in a very small dose. Such a phenomenon has not ever been noticed in the field of radiation biology. It is desirable to make clearer this aspect by further study.

It was said also that similar powerful radioactivities were found at CHIJIWA-town, east 32 km of Nagasaki and at SHIMABARA City, east 44 km of Nagasaki, but the further investigations revealed no evident proof of a powerful radioactivity and also no influence upon the inhabitants of both places.

2. Influence by the Induced Radioactivity.

At the explosion of an atomic bomb, tremendous amounts of neutrons are pushed out. It is theoretically well known that each element will be induced and turned into a radioactive element when it is struck by neutrons. Emission of gamma-rays, which are produced by neutrons striking nitrogen, is an instantaneous phenomenon. These gamma-rays may be a cause of primary radiation injuries, but they will not produce any after damage. At this time, the induced radioactivity of the elements in the human body, for instance, sodium, chlorine, phosphorous, etc., will be considered. Moreover the induced radioactivity of the elements in the ground earth and buildings, for instance, calcium, aluminum, copper, iron, silicon, sulfur, etc., will also be covered. The induced radioactivity of these elements has a very short half-life; 14 days for phosphorous and 15 days for sulfur are elements with relatively long half-lives. Others are several minutes, several hours or several days, and the radiated rays from the activated elements are mainly beta-rays. The injurious action of these radioactive energies may be, therefore, very weak. For example, if 500 grams of sodium chloride were distributed homogeneously in our body, it would be calculated that the total radioactive energies, which are emitted by radioactivated sodium and chloride will correspond to 13.8 r, until they are decayed away. If the ground earth in the central area were to have an induced radioactivity to a depth of 10 cm, the total accumulated radiation dose in 1 - 2 days would be calculated around 500 r. When phosphorous in human bone tissue becomes active and emits beta-rays, the influence upon the bone marrow can not be neglected, even though the dose of the rays is small. By the calculations of Dr. MURATI, Institute of Physical and Chemical Research, we can get the following information. The minimal dose of radioactivity, which can damage human tissue, has been estimated at 0.2 r per day in a 8 hour day. In order to obtain a dose of 0.1 r per day by the induced radiation of phosphorous of bone ashes (incompletely burned, still some black parts remaining), it will be necessary, for beta-ray emission to amount to 1.3×10^4 per minute per gram of the bone ashes.

The results of the surveys by the members of the Kyoto Imp Univ and Institute of Physical and Chemical Research, at Hiroshima, and of the surveys by the members of the Kyushu Imp Univ, at Nagasaki, revealed the following. At both cities, the measured radioactivity of the bone tissues of the human beings and horses, which died in the area within a radius of 500 meters from the ground center, showed sometimes an amount exceeding that mentioned above. But from the bone tissue of the dead victims, outside a radius of 700 meters from the ground center, far less rays could be measured. Consequently, some persons might be affected slightly, when they entered very often in the central area within one week after the bombing, in order to remove or clear away cadavers, or to pick up or collect burned bone ashes. Beta rays were found in such small intensity that they could produce little damage. It may also be imagined that a person, who was affected relatively severely in the central area, would have severe damage to the bone marrow by a continuous radiation emitted by the activated phosphorous in the bone tissue, even though the initial effects by neutrons were not too severe. As those persons would have been, of course, injured in the first instant also by other violent energies, they would have died in the first period.

It may be quite rational, to consider such a possibility. Few investigators believe that bone marrow is damaged enough by activated phosphorous, to be a principal factor in producing a radiation injury in and

after the second period and also bringing patients into a state of lower resistance and thus having difficulty in healing of wounds. We would not like to agree with them. The surveys on autopsy materials of the dead victims in and after the second period, affected mostly outside a radius of 700 meters from the ground center revealed that a certain amount of radioactivity sometimes remained in phosphorus in the bone. The dose was calculated not sufficient to effect the bone marrow tissue, and moreover no remaining radioactivity in the tissue of other organs or blood could be scientifically confirmed.

Iron and silicon elements in a concrete building are worthy to be considered in the problem of induced radiation. It is theoretically estimated that both elements will emit certain beta rays within several days. The building of the branch office of the Nippon Bank at Hiroshima is made of concrete and located at 380 meters from the ground center. It was partly destroyed, but for the most part escaped from the fires. By the initial effects of the bomb, about a 50% mortality was recorded. Soon after the bombing many persons were sent to help and they worked and lived in a room not destroyed. After 4 - 6 weeks some of them were proved to have leukopenia (minimum 2,000 per cmm). However, in the main concrete building of the Hiroshima Red Cross Hospital, no such data was confirmed.

It is certain that for several days after the bombing a sufficient dose of induced radiation was scattered in the concrete buildings in the central area to produce damaging effects, but not enough to produce death.

Contamination of the Bombed Area.

All factors which should be considered in the contamination problem of the bombed area, are proved to exist only a few days, at longest one week, even though they would surely produce a certain damaging effect. The NISHIYAMA district, Nagasaki, is one of the exceptions which we should decide later by further study.

Accordingly we shall not pay any particular attention to contamination in establishing a reconstruction plan of the city. The central bombed area will be kept in the present destroyed condition for the future, as a historical memorial.

From a medical point of view, there are 2 more problems, concerned with the contamination of the bombed area. The first is that the bombed area was an unhygienic area in various ways. The second is that there prevailed some infectious diseases, combined or parallel to the outbreak of the atomic bomb injuries.

Both at Hiroshima and Nagasaki, especially at Hiroshima, all the city was totally devastated and turned into a ruin. Water supplies and sewers and all facilities of the city were destroyed. Consequently, it was a more unhygienic environment than the cities which were destroyed by ordinary incendiary bombs. We cannot say that the cities were favorable places to live even though there remained no specific contamination due to the atomic bomb. There were some citizens who would like to believe that the city was a favorable place to reside, or even to treat wounded and diseased persons, when they heard of no particular contamination. Such a misunderstanding was not desirable.

By various unfavorable circumstances, there prevailed infectious diseases, such as dysentery, typhoid fever and others. These occurred especially at Hiroshima, just after the typhoon attacks in September, 1945. These diseases were observed in combination or in parallel with the atomic bomb injuries. Some of these epidemic or endemic diseases were misconceived as an atomic bomb injury. The victims of these epi- and endemic diseases might be recorded partly as those of the atomic bomb injuries. Consequently we must be careful in treating the problem of the genesis of the secondary atomic bomb injuries.

CHAPTER V.

Protection and Rescue Problems Against the Atomic Bomb

1. Protective Measures.

We would like to discuss now the measure for protection against the effects upon human beings by the atomic bomb. The protection measures against the effects of ordinary bombs can not be applied at all, because the injurious effects of the atomic bomb, as well known by the description in the former chapters, are very powerful and they will act with unimaginable strength at the first instant.

It is obvious that the injurious power of the atomic bomb reduces its intensity by the distances and by the shelters. Consequently we may say, the grade of damages will be slighter according to the separation by the distances from the ground center, and the rate of escape from the effects will be higher according to the protection by the shelters. From these considerations the protective measures will be demonstrated.

The rate of casualties of 898 persons, who were in the area within a radius of 2 km from the ground center at Hiroshima, were as follows. These persons were selected at random and investigated. Out of 134 persons who were in the area within a radius of 0.5 km, deaths 132 (98.4%), wounded 2 (1.6%), and none with no effects. Out of 219 persons in the area between radii of 0.6 - 1.0 km, deaths 197 (90.0%), wounded 17 (7.8%), and not affected 5 (2.3%). Out of 240 persons in the area between radii of 1.1 - 1.5 km, deaths 109 (45.5%) wounded 100 (41.6%), and not affected 31 (12.9%). Out of 305 persons who were in the area between radii of 1.6 - 2.0 km, deaths 69 (22.6%) wounded 151 (49.5%), and not affected 85 (27.9%). It can be noticed that according to the distances from the ground center, the death rate becomes lower, and on the contrary, the rates of wounded and non affected persons are higher.

A direct outdoors action by the primary injurious energies will cause the severest effect in the central area within a radius of 1 km. The mortality is practically 100%, and the grade of damages becomes slighter according to the distance from the ground center. Only slight flash burns will occur in the area outside a radius of 2 km. It is almost safe outside a radius of 4 km from the ground center.

As the mechanical power is very strong in the area within a radius of 1 km from the ground center, it is almost hopeless to escape from a common house, except unusually lucky persons. If a person could escape from crushing injury under a falling house, he would probably not be free from a radiation injury. It is not always safe, even in a concrete building. In the central area, on the upper stories with windows, over one half of the occupants will die and all others will be wounded and affected by radiation. Only in a lower floor in a well covered part in a concrete building, can one escape from the effects.

The persons who are in a wooden house outside a radius of 2 km from the ground center will have no danger to their lives, except those who are unlucky. However they will have slight wounds, probably due to the broken debris of their houses. The persons who are in a concrete building

at a distance of over 1 km from the ground center, will have slighter effects, but they will have wounds by broken glass, when they are on the upper floor with windows. It is fairly safe in a lower covered part of the concrete building.

To prevent burns, one must avoid direct irradiation, that is be covered by some shadow. Among the persons who were outdoors under the same circumstances, a difference of the burn effects was sometimes observed. It may be because the person was covered accidently by a leafy tree, etc. Accordingly the condition of clothing has a close relationship to the burns. In the central area one or two pieces of thin clothing will not be a shelter, but at a distance of over 1 km only a piece of shirt will help a great deal. At a distance of 1.5 km black clothes will be charred and cause scorch burns, white clothes will protect from burns. Clothing such as an army summer uniform protects against burn outside 1.5 km, but uncovered parts of the body are, of course, burned until a distance of 4 km.

Theoretically thinking, at the instant a flash light is recognized the light and heat waves, which will cause burns, have already reached the person. As these radiant rays last a certain time, and as it is necessary for them to act continuously a certain length of time to cause one of the biological reactions - burn, the burns can be avoided or will be slighter in the area outside a radius of 2 km from the ground center, if one takes a protected position as soon as he has noticed a flash light. This avoids some of the effect of the following blast power.

Roughly speaking, the rate of casualties in a concrete building corresponds to that of an open place at a further distance of 900 meters. In other words, the rate of casualties in a concrete building at a distance of 500 meters from the ground center is almost equivalent to that of an open place at 1,400 meters from the ground center.

The surveys on the epilation, a symptom of radiation injury, revealed that there was a difference in distance of 700 meters between the rates of epilation in a concrete building and in an open place; that is, the persons who were in a concrete building at a distance of 800 meters and who were in an open place at a distance of 1,500 meters showed a similar rate of epilation.

In short, the central area within a radius of 1 km from the ground center is a fatal place at the explosion of an atomic bomb for we cannot escape from the effects unless we are sheltered in a perfect underground-type cave-trench. In the area between radii of 1 - 2 km, we can be protected in a concrete building, but not protected in a wooden building. In a circle of a radius of 2 km, a protected position, even taken soon after the recognition of an explosion, cannot help, but outside a radius of 2 km, we will be able to be protected somewhat by taking promptly a protected position. Outside a radius of 2 km there is almost no danger to life, even though some wounds or burns occur. Outside a radius of 4 km we can escape even from the mechanical wounds or burns.

As above mentioned, the safest factor in protection from the atomic bomb explosion is "distance". Accordingly, we should consider at first, the most important protection against the atomic bomb is a provision for the dispersion and evacuation. However these measures are of no use for

personnel protection.

To avoid the atomic bomb effects, we should furnish underground cave-type residential districts, which are well covered by thick concrete walls and live in them. We would like to confess, hereby, frankly that we had no reliable measures when we were considering the protection problem for the whole nation. The most perfect protective measures are no more explosions of the atomic bomb.

2. Rescue Measures.

It should not be forgotten in considering the rescue measures that the injurious power of the atomic bomb explosion is absolutely intensive at the first instant. As already written, about 75% of the cases of dead victims in the central area within a radius of 2 km from the ground center died on the first day and the majority of them were affected first of all by mechanical power. Therefore, there is no way, but to teach the public, how to protect themselves in perfectly sheltered places.

The burned or wounded persons who escaped from immediate death, shall be treated in the same manner as for ordinary burns or wounds. But the symptoms of the atomic bomb injuries are very serious and their prognosis are very unfavorable, compared with the simple burned or wounded cases, because the effects by the atomic bomb are so intense and most persons suffer also from radioactivity. Both at Hiroshima and Nagasaki the majority of the sufferers were treated just symptomatically by simple first-aid measures, because there were swarms of injured cases under very confused condition. We might say that all treatments, which would be good for ordinary severe burned or wounded patients, were also effective for the atomic bomb patients, when they were applied. General treatments especially help the patients a great deal. Among the general treatments, to keep the patients quiet and warm are surely the most simple and also important ones. But these simple measures were almost impossible to apply under such confused conditions, as the fires were catching the whole city and the destructive powerful winds were blowing all over. Personal experience of the medical personnel who worked at rescue measures told us that all victims were treated just by simple first-aid measures for several days after the bombing. Even in the second week, when the confusion became somewhat less, the range of rescue treatments could not extend beyond symptomatic emergency procedures.

At the end of August, that is after 3 weeks, the condition of the rescue treatments in the city of Hiroshima was still in a state of confusion. As all facilities for rescue measures were destroyed in an instant, and so temporary rescue places were prepared for the patients in the remaining buildings, though they were burned and their frames scarcely escaped destruction. Though it was late summer, the patients were lying with one sheet of straw mat on the devastated concrete floor, scarcely keeping from being wet on the rainy days. To give meals was sometimes the only help possible.

Complete treatment could not be, therefore, possible. Moreover, after 3 - 4 weeks, many persons who escaped from early death, suffered from the symptoms of radiation injuries and were dying one after another. All citizens were thrown down in a depth of complete desperation, while

they were seeing many patients passing away near them.

At that time we were staying at the UJINA Branch Hospital (Capt SATO in charge) of the Hiroshima Army Hospital, to treat and to study the atomic bomb patients. There were special parties for the investigation, sent by the Army Medical School and by the Tokyo Imp Univ. After hard efforts at careful studies for several days, we got temporary conclusions as to the treatment of atomic bomb injuries. On September 1st we had a special conference at the UJINA Hospital, and all staff members of the UJINA Hospital, of the Army Medical School party and of the Tokyo Imp Univ party attended. We discussed and decided the principles of treatment for the atomic bomb injuries. At the time, all citizens of the City of Hiroshima were feeling hopeless desperation, because the damages by the atomic bomb were so severe. Even the medical personnel was going to give up their work, losing all hope. We presented, therefore, our notes on the treatment of patients, even though they were in an uncompleted form, in order to help the suffering people, psychologically at least.

Then, at Hiroshima, I myself presented a hand written copy of my vivid personal experiences in an explanation of the principles of treatments to the medical circle and the public through a local news paper. The following is a part of the original hand writing of mine.

- -

The Principles of the Medical Care of the Atomic Bomb Radiation Injuries.

Almost all the persons who were in the area within a radius of 500 meters suffered from the severest injuries and died immediately or afterward, to our great sorrow. These victims had received a fatal effect at the moment of the explosion. It is almost hopeless to help those persons by medical care, except in a miraculous case.

The persons who were in the area between radii of 500 - 1,000 meters, had severe burns and at the same time they were also effected by radioactivity. The majority of the cases have died already. The persons who were in the houses, were pressed and died under the falling houses or were injured and burned to death in their burning houses. Some persons escaped fortunately without any burn or wound, but most of them suffer in 2 - 4 weeks from the so-called radiation injuries, complaining of epilation, fever, bleeding etc., and are dying one after another. We cannot watch this miserable condition without tears.

Among the persons who were in the area between radii of 1 - 2 km from the ground center, we have found already some radiation injuries and dead victims at a considerable rate.

One month has already passed since the affair occurred. The clinical course of the atomic bomb radiation injuries might be considered to have passed over the peak and is going into the descending phase of the disease, judged by the clinical as well as the path-anatomical studies on the patients. Hereafter new patients will be reduced in number and after one month more, i.e. in the beginning of October, no severe case will be seen any more. It may be understood that the damages of the blood and the

internal organs are proceeding already into a recovering stage. It has been well known that a single damage by radioactivity can recover, if it is tolerated.

Therefore, we would like to propose that we must do our best in the medical care and help. We are to throw away, of course, such a fatalistic attitude as prevails in a limited circle.

Now the principles of medical care for radiation injuries will be discussed in the following. The measures, which will be presented here, are limited at first to such ones as we can easily apply now in and around the City of Hiroshima, in spite of the difficult conditions on all sides. If it is possible, it goes without saying, perfectly complete measures of medical care are to be taken up further.

1. To the patients, with symptoms of epilation, stomatitis, bleeding, fever, etc.
   (1) Severe cases (unfavorable general condition, the white blood count under 1,000, poor prognosis expected):
      a. Symptomatic treatment (special care by sedation, cardiants, and hemostasis etc.)
      b. Apply the following measures for the moderate cases, if it is possible.
   (2) Moderate cases (epilation, stomatitis, diarrhoea etc. A general feature is not so severe, the white blood count is over 1,000).
      a. General care, especially to keep quiet and to give fresh and nutritious foods.
      b. Protein therapy: for example, an intramuscular injection of auto blood (20 - 30 cc of auto-blood, taken from an arm vein and injected immediately intramuscularly in the upper thigh. It is surely better to transfuse fresh blood of the same type, 100 cc a day, if it can be done. Blood transfusions must be performed under the most careful manipulations and infused very slowly; if not, you will have a severe undesirable reaction.
      c. Large dose of vitamins B and C. Fresh vegetables and fruits.
      d. Calcium preparation; for instance, calcium chloride, Iodinon-calcium (calcium in glucose): 20 cc 1 - 2 times a day intravenously.
      e. Liver preparation: raw liver, roast liver, or liver powder, etc.
      f. Saline solution, Ringer's solution, 5% glucose solution: 500 cc a day subcutaneously. Avoid infusions of these solutions directly into the veins.
   (3) Slight cases (slight epilation; epilated once, but already stopped, slight gingivitis or diarrhoea, or recovering stage of these symptoms, the white blood count 3,000 - 1,000).

Apply the above mentioned care of the moderate cases. Special attention must be taken to keep quiet. The symptoms may become suddenly worse in the recovering stage, even though the cause be slight.

2. To the patients, without any clinical symptoms.

(1) The persons who were in the circle of a radius of 2 km from the ground center at the explosion (in a circle, passing through the Hiroshima Station, HIJIYAMA-mountain, MIYUKI-bridge, TEMMA-bridge, the YOKOGAWA-Station), must have immediately a medical consultation, if they have had some of the following symptoms since they were bombed, even though they had neither burn nor mechanical wounds. These persons are said now to be latent patients, for they can easily become ill in the coming 1 to 2 months by very slight causes. So they must take care of themselves under the advice of a doctor for it is necessary to recover condition of health as soon as possible.

a. Vomiting or anorexia in several days after the bombing.
b. To feel a remarkable general fatigue or to have felt it.
c. Diarrhoea, like dysenteric, even slight.
d. Sore throat.
e. Slight epilation after 10 - 14 days, but it has ceased already.

(2) Among the persons who were in the area outside a radius of 2 km and inside of a radius of 4 km from the ground center, some were burned slightly, some were injured slightly by broken glass, etc., and others were not apparently injured at all. Even those uninjured persons may be really effected by the radioactivity. All these persons are, therefore, to be consultated by doctor at an early occasion and to be under the doctor's control. They must also take care of themselves, in avoiding over work, taking sufficient rest, having fresh vegetables, especially fresh fruits. The most important is, not to take cold and not to have digestive troubles in the coming 1 - 2 months.

3. Suggestions to the doctors, who are on duty:

As far as symptoms and treatment of the atomic bomb radiation injuries are concerned, it is clear by the former descriptions. Finally I would like to say something about the principles of medical care for the so-called latent patients. The severity of the radioactive effects is determined by the distance from the ground center. The persons who were in the circle of a radius of 500 meters from the ground center, have died for the most part already. The persons who were in the area between radii of 500 - 1,000 meters, are suffering now and the majority of them are showing very severe symptoms, many of them have died already. From the stand point of medical care, the persons who were in the area within a radius of 2 km from the ground center, must be under the same control as the slightly affected patients, even though they have no manifest symptoms. Especially great care must be taken to avoid working too hard, taking cold, or having digestive troubles, etc., which may be one of the direct causes for an outbreak of the sickness.

The persons who were in the area between radii of 2 - 4 km from the ground center, are affected also slightly. Their white blood counts may be around 4,000. These persons must take care of themselves in the coming 1 - 2 months and recover their health as soon as possible. These persons

will have weak resistance to muscular labor or an acute inflammatory disease. To these aspects we must pay special attention.

To diagnose the grade of the radiation damage, a count of the number of the white blood corpuscles in the peripheral blood is the most exact method. But in and around the City of Hiroshima at the present time, the white blood count is very difficult to be practiced sometimes it is almost impossible. The next best measure instead of a white blood count is a measurement of the sedimentation of the red blood corpuscles. Over 30 mm in one hour value will indicate a suspected patient, over 50 mm in one hour value a slight affected patient.

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The treatment of radiation injuries in the second period has been described adequately in the foregoing part. In fact, by our personal experiences at the UJINA Branch Hospital of the Hiroshima Army Hospital of about 500 patients (mostly severe or moderate radiation injuries, without any remarkable burns or wounds, a few had slight burns or mechanical wounds), a relatively easier practical and effective method of treatment is an intramuscular injection of auto-blood. It is a help in stopping progressive change and stimulating regeneration of the blood.

The most important measure for the treatment of the atomic bomb radiation injuries is careful protection. All patients are effected more or less by the radioactivity, these must recover by their own vital power. In the cases in which the vital organs were damaged beyond their ability to recover, medical care at the present time cannot help. We may have some hope for recovery as long as any reserve power is remaining because the radiation exposure has occurred only once. We must, therefore, avoid such treatment as whipping a tired horse hastily. In other words, we should not be over-confident in the ability of our medical care. Our aim shall always be a promotion of the natural healing powers.

ADDENDUM

List of the Reports on the Medical Studies, Presented by February 28, 1946

I. National Research Council, the Special Committee for the Investigation of the Effects of the Atomic Bomb.
   1. Preliminary outlines of the results of the investigations.
   2. Report (shorthand) of the first general meeting (11 Nov., 1945).
   3. Report (shorthand) of the second general meeting (28 Feb., 1946).

II. Japanese Army.
   1. Army Medical School and the Tokyo First Army Hospital: Medical report of atomic bombing in Hiroshima.

III. Japanese Navy.
   1. KURE Naval Station: Surveys of the atomic bomb at Hiroshima (general aspects).
   2. KURE Naval Station: Surveys of the atomic bomb at Hiroshima (medical aspects).
   3. KURE Naval Station, Medical Department: Studies on the biological action of the atomic bomb (the second report).
   4. KURE Naval Station, Medical Department: Studies on the biological action of the atomic bomb (the third report).
   5. KURE Naval Station, Medical Department: Studies on the biological action of the atomic bomb (the fourth report).
   6. National Research Council, Special Committee, Medical Section, Naval Team: A preliminary report.

IV. Tokyo Imperial University, the Faculty of Medicine.
   1. MIYAKE: Preliminary report on the path-anatomical studies of the atomic bomb cases in the City of Hiroshima.
   2. NAKAO & others: Clinical observations of the atomic bomb patients at Hiroshima.
   3. MURATI & MURAI: Survey on the human damages in the typical strong constructed buildings at Hiroshima.
   4. MURATI & MURAI: Relations between the human damages and substances of the shelters at Hiroshima (1).
   5. KITAMOTO & ISHIKAWA: The human damages by the atomic bomb in a building at 200 meters from the ground center.
   6. URABE, OHASHI, UYEDA, HAKAMADA & NIKAIDO: Reports of the inspections of the cave-trenches around the hill of prison in the City of Nagasaki.
   7. URABE, OHASHI, UYEDA, HAKAMADA & NIKAIDO: Reports of the inspection of the casualties in the buildings of SHIROYAMA Public School at Nagasaki.
   8. URABE, OHASHI, UYEDA, HAKAMADA & NIKAIDO: Reports of the inspection of the casualties in the buildings of CHINZEI Middle School at Nagasaki.
   9. URABE, OHASHI, UYEDA, HAKAMADA & NIKAIDO: Reports of the inspection of the casualties in the buildings of FUCHI Public School at Nagasaki.

10. MASUYAMA: Stochastic studies on the atomic bomb casualties at Hiroshima. I. Death rate distance curve.
11. MASUYAMA: Stochastic studies on the atomic bomb casualties at Hiroshima. II. Death rate date curve.
12. MASUYAMA: Stochastic studies on the atomic bomb casualties at Hiroshima. III. Comparison of the death rate of male with that of female.
13. MASUYAMA: Stochastic studies on the atomic bomb casualties at Nagasaki. II. Death rate date curve.
14. KASHIMADO: Contribution to the problem of the causes of deaths of the atomic bomb victims.
15. The Medical Parties of the Tokyo Imp Univ: Reports of the surveys on the atomic bomb cases at Hiroshima.
16. OHASHI, URABE, UYEDA, HAKAMADA & NIKAIDO: Distribution of the symptoms of the atomic bomb patients at Nagasaki.
17. UYEDA & NAKAIDO: Timely distribution of the symptoms of radiation sickness at Nagasaki and the blood pictures after the second month.
18. NAKAO, KOBAYASHI & others: Hematological study on the atomic bomb disease.
19. NAKAO, OKOSHI, KAKEHI, TSUKADA, KATO & KAWAMURA: Statistical observation of the peripheral blood pictures of the atomic bomb patients in the 3rd and 4th months.
20. UYEDA & NIKAIDO: The attitude of the eosinophile cells in blood and bone marrow of the atomic bomb patients at Nagasaki, in the 3rd and 4th months.
21. AYUKAWA & others: Resistance of skin capillaries and their micrograms of the atomic bomb patients at Hiroshima.
22. KOBAYASHI & others: Disturbances of the function of liver and capillary of the atomic bomb patients.
23. FUKUDA & WATANABE: Disturbances of the function of liver of the atomic bomb patients.
24. KUBO & KITAMOTO: On the fever of the atomic bomb patients at Hiroshima.
25. KITAMOTO & others: Some statistics of fevers, fatigue feelings and complications of the radiation sickness.
26. KUBO: Surveys on malnutrition of the atomic bomb patients at Hiroshima.
27. URABE & MENJO: On cachetic condition of the atomic bomb patients at Nagasaki.
28. URABE & MENJO: Contribution to the cachetic condition of the atomic bomb patients.
29. KITAMOTO & AYUKAWA: Atomic bomb effects and tuberculosis of the chest.
30. KISHIMOTO: Gastro-intestinal tract, the TAKATA tests and urine examination of the atomic bomb patients at Nagasaki.
31. HINO: Chloride content of blood of the atomic bomb patients in the OMURA Naval Hospital.
32. YAMAMURA: Some clinical studies upon the atomic bomb patients at Nagasaki, in the OMURA Naval Hospital.
33. KAJITANI & ISHIBASHI: Clinical and path-anatomical studies on the scar tissues after the atomic bomb burns.
34. KUWABARA: Remarkable facts of the atomized patients at Hiroshima.
35. ASAKURA: Report of the atomic bomb patients at Hiroshima. (Protein of blood and sperm).

36. SIMIZ: Atomic bomb influence upon human sperm.
37. OKOSHI, ASAKURA & KASEKI: On the sperm of the atomic bomb patients at Hiroshima.
38. MITANI, ITO & others: Influence of the atomic bomb upon the sexual function of the females (an intermediate report).
39. KASHIWADO: Atomic bomb effects in the oto-rhino-laryngologic field.
40. SHOJI & FUKUOKA: Clinical researches of ocular affections caused by atomic bomb explosion at Hiroshima.
41. OKADA, SHIMAZOHO & HAKAMADA: On the brains of the atomic bomb victims.
42. AKIYAMA: The investigation of oral diseases of the atomic bomb patients at Hiroshima and ZAMBRINI-WATANABE's salivary reaction.
43. MIYAKE: Path-anatomical studies of 34 atomic bomb cases at Hiroshima and Nagasaki (the first report).
44. KAJITANI, HATANO, YASUDA, ISHIKAWA & GOTO: Statistical observation of the atomic bomb burn patients at Hiroshima.

V. Kyoto Imperial University, the Faculty of Medicine.
1. National Research Council, Special Committee, Medical Section, Kyoto Imp Univ Team: A preliminary report.
2. Research Commission of the Imperial University Kyoto: A preliminary report on the disaster in Hiroshima City caused by the atomic bomb.
3. KIMURA & others: Bacteriological researches on the serum of patients who were injured by the atomic bomb at Nagasaki.
4. INOUE & others: Clinical research for the atomic bomb injury, with special reference to the functional disturbance of the adrenal glands, the liver and the cause of the blister formation on the skin (primary report).
5. TSUDA & ADACHI: Hematological observations on 3 patients injured by the atomic bomb (about the regenerative blood pictures and the influence of the blood transfusion upon them).
6. Pathological Institute: Report on the atomic bomb effect at Nagasaki (the first report).
7. KIKUCHI & others: Clinic of the so-called radiation sickness (survey at Hiroshima).
8. KIKUCHI & others: Clinic of the so-called radiation sickness (survey at Nagasaki).
9. FUNAOKA & others: On the biochemical and physicochemical changes of the blood of the atomic bomb patients.
10. SHIMIZU & others: Electrocardiograms of the atomic bomb patients.
11. TOMITA & others: Studies on the skin capillaries of the atomic bomb patients.
12. NAITO: On the cerebrospinal fluid of the atomic bomb patients.
13. MINOGUCHI: Oral findings of the atomic bomb patients.

VI. Kyushu Imperial University, the Faculty of Medicine.
1. National Research Council, Special Committee, Medical Section, Kyoto Imp Univ Team: A preliminary report.
2. NAKAJIMA & ISHIKAWA: Investigation of injuring effect upon the human body by the explosion of atomic bomb at Nagasaki City.

3. KATSUKI & others: Survey of the radioactive influence by the atomic bomb which was used at Nagasaki, upon the inhabitants in the districts of CHIJI"A-town.
4. ONO, IMAI & others: On the pathologic anatomic changes in the atomic bomb disease.
5. ONO, IMAI & others: A supplementary report of the pathologic anatomic changes in the atomic bomb disease.
6. HIROHATA & others: On some chemical constituents of the blood of the atomic bomb patients.
7. OTSUBO & ISHIZAWA: The report of hygienic investigation with regard to the continuous actions of damage in consequence of the atomic bombing at Nagasaki.
8. MISAO & others: Clinical observation of the atomic bomb disease.
9. MISAO & others: On a case of monocytes leukemia, occurring after the atomic disease.
10. KUSUNOKI & others: The research on atomic bomb victims.
11. SAWADA, KAIDA & others: The clinical investigation of the atomic bomb disease.
12. HIRAO: On the atomic bomb injury and the function of liver.
13. KOGA: Change of the gastric intestinal organs by the atomic bomb injury.
14. ENJOHJI & others: Atomic bomb disease in childhood.
15. ENJOHJI & others: The bacteriological and serological researches for diarrhea of atomic bomb disease.
16. TAMURA & others: The injuries of the eyes by the atomic bomb.
17. SASAKI & others: On the lesions of the pharynx and the larynx by the atomic bomb.
18. MINAMI: Dermatological view of the lesions caused by the atomic bomb.

VII. Osaka Imperial University, the Faculty of Medicine.
1. FUKU SHIMA & others: The pictures of blood and bone marrow of the patients injured by the atomic bomb.
2. FUSE & others: Medical effect of the atomic bomb.
3. YASUOKA: The relation between flash burn and radiation sickness by the atomic bomb.

VIII. Nagoya Imperial University, the Faculty of Medicine.
1. SAITO: On the injured patients by the atomic bomb.

IX. Kyoto Medical College (Kyoto Prefectural).
1. NAKAGAWA: Case reports on patients caused by atomic bomb.
2. KURUSU: Report on the atomic bomb patients.
3. Pediatrics clinic: Case reports on the atomic bomb patients at Hiroshima and Nagasaki.

X. Okayama Medical College.
1. HAYAMOTO & YAMANOUCHI: Active SH-base of serum protein of the atomic bomb patients.

XI. Nagasaki Medical College.
1. Nagasaki Medical College (KOYANO, dean): The situation of the people in Nagasaki Medical College on August 9th, 1945.

2. Nagasaki Medical College (SHIRABE, prof.): Data of the statistical surveys of the casualties by the atomic bomb at Nagasaki.
3. KOYANO & others: Memoranda on the self-experience of the atomic bomb as a medical man (Handwritings).
4. OSAJIMA & others: Survey of the radioactive influence, caused by the atomic bomb which was used at Nagasaki, upon the inhabitants in the City of SHIMABARA.
5. OKURA: Santonin test on the liver function of the atomic bomb patients at Nagasaki.
6. ICHINOSE & others: Shortening of the resorption time of a pomphus of the skin of the atomic bomb patients.

XII. Kumamoto Medical College.
1. National Research Council, Special Committee, Medical Section, Kumamoto Med College Team: A preliminary report.
2. KAMEDA: Report on the atomic bomb patients at Nagasaki.

XIII. Osaka Medical School.
1. YAMAZAKI: On the late radiation sickness by the atomic bomb.

XIV. Osaka Womens' Medical School.
1. Takahara: Oto-rhino-laryngological findings by the atomic bomb effect.

XV. Yamaguchi Medical School.
1. OZAWA: Reports of the atomic bomb cases.
2. YAMORI: Report of pathological research of the subacute atomic bomb cases at Nagasaki.
3. MONDEN: My experience of the atomic bomb disease.

XVI. Hiroshima Sanatorium, SAIJO-Town.
1. FUJII: The effects of the atomic bomb on the human beings at Hiroshima.

XVII. Jikei Service Cooperation, Tokyo, and Shohara-machi Red Cross Hospital, Hiroshima Prefecture.
1. NISHIMARU & others: Atomic bomb effect and white blood corpuscles.

XVIII. Kawskita Hospital, Tokyo.
1. HOSHI: Case reports of the atomic bomb disease.

XIX. Railroad Hospital, etc.
1. MATSUFUJII: (Laboratory for the scientific research of physical and labor affairs): Survey of the members of the railroad service at Hiroshima.
2. OKUTANI (MOJI Railroad Hospital): Case reports of the atomic bomb patients.
3. HATANAKA (MOJI Railroad Hospital): Relation between the atomic bomb effects and menstruation.
4. YOSHIMURA & others (Nagasaki Administration Bureau): Report of the physical examination of the members of the railroad service at Nagasaki.

XX. Tokyo Imperial University, Institute for Infectious Diseases.
1. National Research Council, Special Committee, Medical Section, Institute for Infectious Diseases Team: A preliminary report.

XXI. Institute of the Welfare Ministry.
1. National Research Council, Special Committee, Medical Section, Institute of the Welfare Ministry Team: A preliminary report.

PART IV

PHOTOGRAPHS

These are representative photographs taken at Hiroshima and Nagasaki which show the residual effects of atomic bomb damage to survivors about 16 months after the attacks.

The photographs were taken by Dr. Paul S. Henshaw with the cooperation of the U. S. Army Signal Corps.



Hypocenter of the bomb blast at Nagasaki as it appeared in December, 1946. This marker was erected on the site by the Japanese.



This Hiroshima survivor sustained burns which healed with keloid or scar formation on left side of neck. Her child, born in April 1946, appears normal.



This patient is being treated for scars resulting from burns received from the atomic bomb explosion at Nagasaki. These burns healed with large keloids or areas of scar tissue and depigmentation of the surrounding skin.



This patient received burns on both legs from the atomic bomb explosion at Nagasaki. The healing of the left leg was prolonged and a large amount of scar tissue recurred in the areas after skin grafting. Scar tissue has also appeared in donor sites on thigh from which skin was taken for grafting.



This patient sustained gasoline flash burns when an incendiary bomb was dropped on Tokyo. These burns also healed with scar tissue or keloids.



These high school students in Hiroshima now show well healed but heavy scars due to atomic bomb burns.

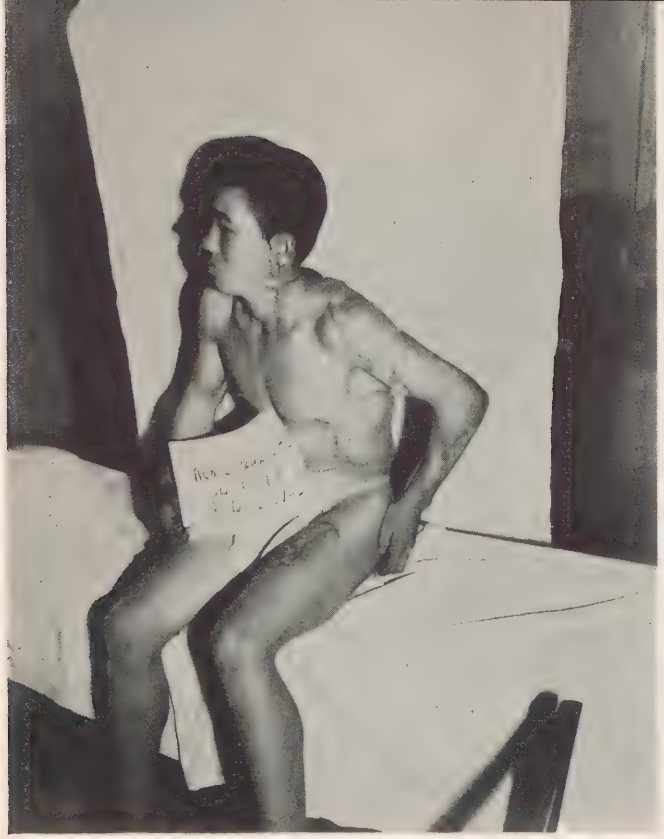


Another group of Hiroshima students show thick scars or keloids on right side of their necks and faces where burns resulted from the atomic bomb explosion.

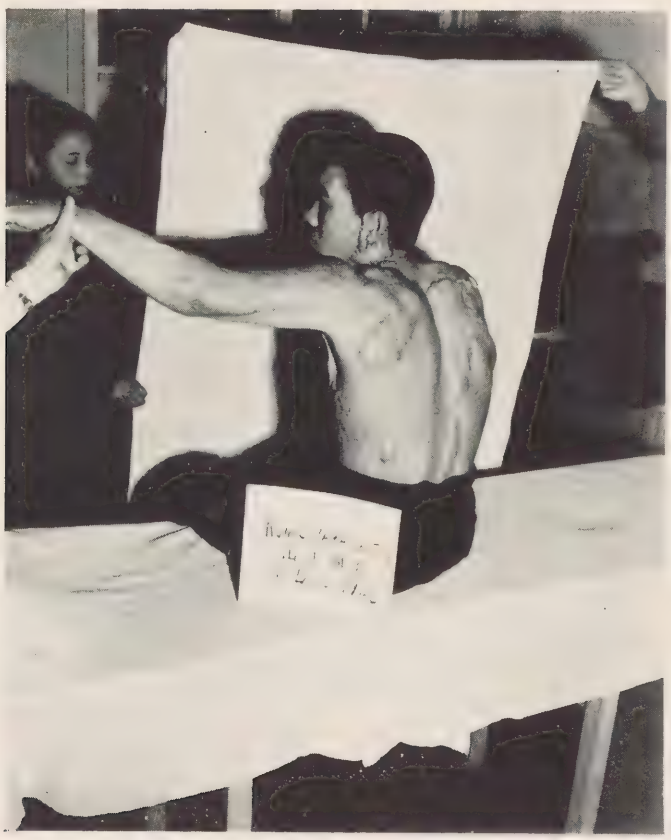




Two photographs of this patient, a survivor of the Nagasaki bombing, show the heavy scar tissue which followed healing of burns.







These three photographs show the massive keloid formation following burn healing in another survivor of the atomic bomb explosion at Nagasaki. Scar tissue also occurred later on patient's left thigh where skin was removed to graft a burned area. This patient wore no shirt and was standing with arms crossed behind him as shown in the upper photograph at the time of the explosion. Lower photograph indicates how the burn and subsequent scar tissue or keloid formation followed the line of patient's arm.





This child was on its mother's back at the time of the bombing of Hiroshima. The child sustained burns on both legs and feet and the mother on face, neck, and arms. Severe contractures developed from burns on legs of child, drawing the feet up as indicated in the lower photograph. These have now been treated with skin grafts, as shown above.

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